SIX METERS

A GUIDE TO THE MAGIC BAND

by Ken Neubeck, WB2AMU

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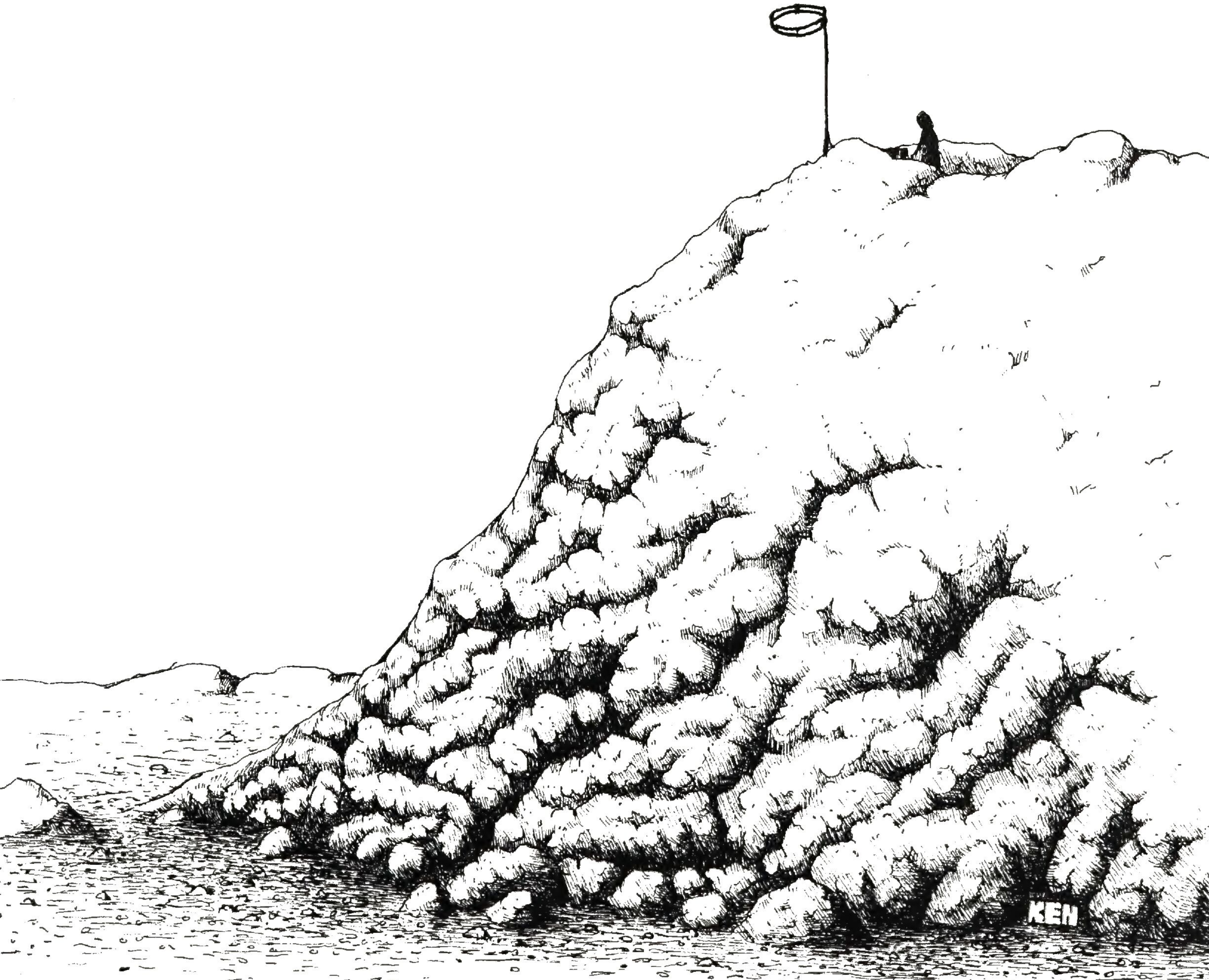

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BOOKS

Published by ***Worldradio Books***

2120 28th St., Sacramento, CA 95818 USA

DEDICATION

This book is dedicated to my wonderful XYL, Fran.

ACKNOWLEDGMENTS

I would like to thank the number of hams who helped me put together this book. In particular, I would like to thank Larry Jones, WB5KYK, and Frank Moorhus, AA2DR, for their significant input on their area of expertise in Six Meters. Larry provided much of the information on meteor scatter propagation and Frank provided information and original advertisements for many of the old Six Meter equipment and antennas. Additionally, I would like to thank Hank Arsaga, W5VAS, Ron Beausoleil, N2NBY, Joe Crawford, WA4AUX, Byron Fletcher, G6HCV, Fred Franke, WB2NFO, Tom Glaze, KC4SUS, Ken Goldstein, N2MYW, Ron Graham, VK4BRG, Harold Grounds, W9JMS, Ron Klimas, WZ1V, Mitchell Lee, KB6FPW, Joe Nehm, NI1L, Ray Neubeck, W2ZUN, Emil Pocock, W3EP, Mike St. Angelo, N2MS, and Sid Wolin, K2LJH for various bits of information or editing that they provided for this book.

Finally, I would like to thank ***Worldradio*** and its publisher Armond Noble, N6WR, for giving me a chance to write for them on one of my favorite subjects and for being able to devote an entire book to Six Meters.

PUBLISHER'S NOTE

It is with great pleasure that we present Ken Neubeck's book about Six Meters.

The first band I was active on was 50 MHz. That was in the late 1950s. Living in Wyoming (K7MFA) was like being in Albania or Bhutan on 20 Meters today. You got a lot of calls when the band was open.

My rig was a Heathkit "Sixer." Five Watts in and, on a good day, one Watt output. My antenna was a dipole about 20 feet high. One day I worked eight states. One of my Six Meter friends in Casper said "Maybe you heard eight states, but you didn't work eight states with that setup."

I replied, "We'll see when the QSL cards come in." Which they did.

Later I lived in Montana and Idaho. Yes, Six Meters could be very exciting.

Ken's book brought back many memories of those times and makes me want to get on the band today.

Armond Noble, N6WR
Publisher, ***Worldradio***

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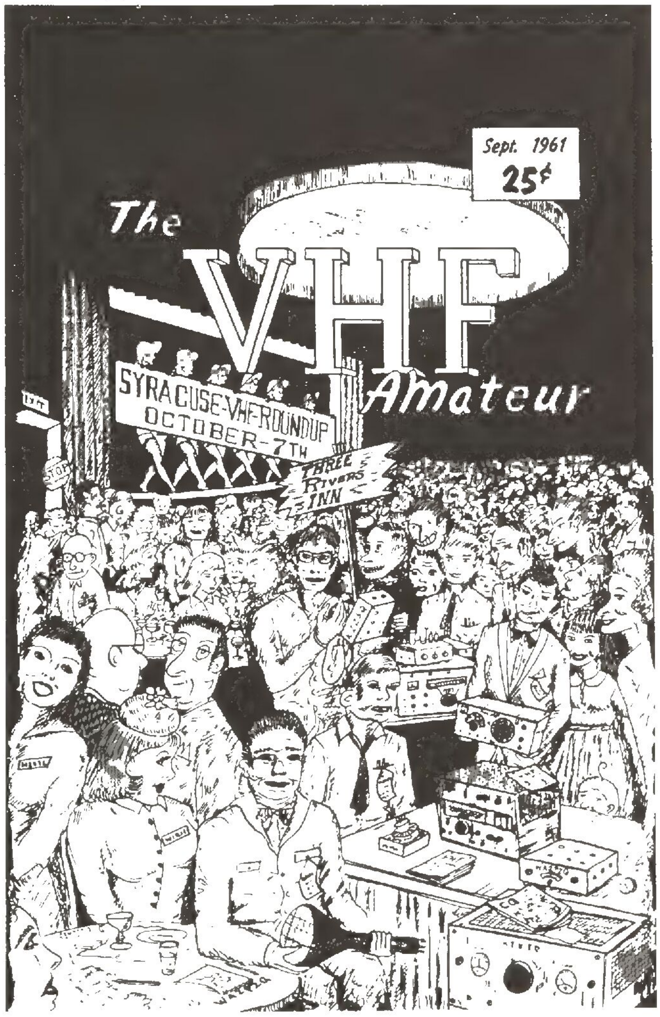
Chapter 1
An Introduction To The Magic Band

Here is a book at long last which is solely dedicated to Six Meters, affectionately known as "The Magic Band" to those who use it. In the past, Six Meters usually had to share a book with other VHF bands such as Two Meters and the 70 cm band. It seemed that VHFers really did not know what to do with The Magic Band. This is evident by the relatively sparse use of the band for FM and repeater activity. There is seldom much mention of Six Meters in DX books, which seemingly only cover the HF frequencies. The radio handbooks cover the Six Meter band in a pedestrian manner and one would not get the spark or initiative to start on the band just by reading these handbooks. This book attempts to put it all together so that there is one source that hams can use when finding out about The Magic Band.

The Six Meter Amateur Radio band is without a doubt the most interesting range of Amateur Radio spectrum that hams have access to, yet it is the most under-populated of all of the bands. It is a band where many different forms of propagation appear, more so than any other band. In addition, it is the one band where all of the different modes of transmission may be found, ranging from weak signal modes like CW or SSB to FM repeaters. The Six Meter spectrum of 50 to 54 MHz is a vast spectrum yet it is sadly under-populated. Ironically, greater than 90 percent of the United States Amateur Radio operators have access to this band, starting from the Technician license class, but the total percentage of the hams that use this band on a regular basis is less than five-percent. It's a great piece of real estate just waiting for hams to discover its capabilities and potential.

This unique band, besides being called The Magic Band, is often called the "borderline band" as it exhibits both VHF and HF characteristics at different times of the year while bridging the gap between the HF bands and the Two Meter band. There are many different types of skip conditions that can affect the band more so than any other band. Propagation caused by Tropospheric skip, Aurora, backscatter and meteor showers are not uncommon on this band. The most common of these is Sporadic-E, which affects this band more than any other Amateur Radio band. With the increase of countries being allowed access to Six Meters in recent years (along with various award programs and contests) the word is getting out about the amazing phenomenon that takes place in this frequency range.

There are many reasons for the underpopulation of the Six Meter band. Unfortunately, it has the stigma of being called the "TVI band," which has curtailed interest by prospective operators. While it is true there is an inherent problem, particularly in areas where television Channel 2 is used, these problems are not insurmountable and can be corrected by appropriate action. Another problem is the lack of affordable gear on Six as there has been limited production runs of gear throughout the past two decades. Only in recent years is it being considered as a regular option for



From the 1960s, a cover from one of the VHF magazines which covered Six Meters on a regular basis.

new HF transceivers. There is an educational problem associated with Six Meters and this book hopes to correct misconceptions and myths that hams may have about this band. First a little history.

U.S. Amateurs first had access to the Six Meter band in March of 1946 when they were moved off of the Five Meter (56 MHz) band and relocated to the Six Meter band. This re-allocation took place in order to accommodate a new block of VHF TV channels by the FCC. However, Six Meters quickly gained its nickname as the "TVI band" when it was discovered that it interfered with TV Channels 1 and 2. This problem would result in another move when Channel 1 in the 44 to 50 MHz range was eliminated. The ARRL petitioned the FCC to eliminate Channel 2, not only because of Six Meters, but also because of the second harmonic of Ten Meters falling in this range of 56 MHz. However, that was rejected and Channel 2 TVI became the cross that had to be borne by those who operated Six, even to this day, in areas of the country where this channel is active.

During the 1950s and 1960s, a large amount of commercial gear became available that could be converted to Six Meter Amplitude Modulation (AM) operation. Six Meter AM was thought of as a good local communication mode for line-of-sight work. In addition, it was used as part of the Civil Defense emergency network by hams involved in public service. Six Meters was particularly popular with the Technician class hams and this led to the label "Technician's band." It was the reward (or punishment!) for all those hams who could not master the 13 WPM requirement for code. A large number of Six Meter rigs came out at this time, notably models made by Clegg and Gonset. Other manufacturers had at least one Six Meter model to accompany their HF series. Typically these rigs had the AM mode and had sockets for one or two crystals, as internal VFOs were not too common during those early days. There were also homemade AM rigs built from information in the *ARRL Handbook* and the pages of Amateur Radio magazines. Typically, these AM rigs put out between 5 and 20 Watts and adapted for mobile work by use of an inverter power supply. Verticals and halos were the antennas for mobile work and it was not uncommon to see a 4½ foot quarter-wave whip mounted on car bumpers. Besides mobile communications, Six was also used during this time for the developing hobby of radio control boats and airplanes. SSB was making an entrance to the band in 1960 and caught on fast. This time period was truly the "golden age" of Six Meters.

However, by the mid-1960s things were changing that would affect the popularity of the Six Meter band. First, there was always that problem with television interference with Channel 2 that was not alleviated by the AM rigs that used tubes and were not filtered effectively. Six Meter operation at home was restricted, if not curtailed altogether, because of this problem. Even more so, was the development of the Two Meter FM band, which was becoming very popular with hams for local use. Two Meters presented less problems with TVI, a fact appreciated by hams in the crowded areas. The smaller wavelength was ideal for antenna work and along with the development of Two Meter repeaters, was attracting more hams to that band. Such would eventually spell doom to Six Meters as a widely used mobile band, which continues to this day. Six Meters seems to have gone the same way as the accordion, a popular instrument in the 1950s and early 60s and has faded from popularity since then. This may seem like a strange analogy but the similarities in the popularity curve are very similar.

Strangely enough, as Two Meter FM became popular, the slow growth of the FM mode on Six Meters actually contributed to the general mix of modes that you see on the band at the present time. It seems that there is more weak signal work done on Six in the way of CW and SSB. AM though, still retains a strong presence on the band. That is the beauty of this band, no one mode can claim an overwhelming majority.

Six was used primarily for local communications during the 1950s and 1960s. Users of the band however, became aware of a strange phenomenon making it possible for long distance communications to take place with distances of up to 1,000 miles. This phenomenon is Sporadic-E skip. I was first exposed to this phenomenon on Six when I scanned through the logs of my father, Ray Neubeck, W2ZUN, of those earlier days and saw a contact that he made from Long Island, NY, using his mobile AM radio to a VE5 station in Saskatchewan. This phenomenon was not understood too much then and it is still misunderstood by many hams to this date. This phenomenon, along with other modes of propagation challenged the proposition that Six Meters was merely a local band and would make it the focus of attention of many hams interested in long-range communications.

Fifty MHz is the most unique of the frequencies that radio amateurs have access to. As mentioned earlier, it is sometimes called the "borderline

band" as it exhibits both VHF and HF characteristics. Believe it or not, it is a good DX band during the right time of the 11-year sunspot cycle and a number of hams have worked 100 countries for the DXCC award. There are many different types of skip conditions that can affect the band more so than any other Amateur Radio band. Propagation caused by Tropopheric skip, F-layer, Aurora, backscatter and meteor showers are not uncommon in this band. But, the most common of these skips is Sporadic-E, which affects this band more than any other Amateur Radio band. All of these forms of propagation will be discussed in this book in great detail.

The author with his first Six Meter rig, the Swan 250, affectionately known as "the beast." This rig had a number of faults, but it put out a tremendous signal. It is one of the more commonly used rigs that can still be found at ham radio flea markets. — photo by Fran Neubeck

Nothing can be taken for granted on Six Meters. A great deal of the time, the band is quiet. It isn't a band like 20 Meters, where a station in the eastern part of the United States can reasonably be able to make a QSO with Europe just about any day of the year. On the contrary, it is very unpredictable and hence falls in the class of an experimenter's band. Even during the height of the Sporadic-E season, you can not reliably predict what days and where the openings will occur. Despite this inherent unpredictability and lack of reliability, I found it very easy to get addicted to this band and developed a sort of "50 MHz obsession." It defies logic — why fall in love with a band like this? I think it's because when conditions appear out of nowhere, it becomes easy to become amazed by such events. After all, who would have believed that a stateside station can work into Europe on Six Meters? Doesn't conventional thinking say that Six is a VHF band? The trick is to be there when an opening occurs.

Six Meters qualifies for still another nickname — the Gentlemen's Band. There is virtually no monkey business on this band that might be found on some of the HF bands or on Two Meter repeaters. That is because, as suggested by my friend Ron Beausoleil, N2NBY, it takes a little bit of effort to get on this band and if you do something foolish, nobody will talk to you and your investment in your equipment will be wasted. I have not seen any poor behavior such as you would find on 20 Meters when DX stations come on and a pileup ensues. Six is a band without class distinction. All frequencies are available to the Technician class and above. Nobody really worries about your license class when you get on Six; only the fact that you are a good operator really matters.

I didn't find it easy to get started on the Six Meter band. In the first place, I would be discouraged by other hams who would say, "Why do you want to go on Six anyway? It's a TVI band." Secondly, it wasn't very easy to find used gear suitable for getting started. In my case, my first Six Meter rig was a Swan 250, not too user friendly, particularly in the area of frequency calibration and tuning. Once I figured the Swan 250 out, I was dismayed to find the band always quiet when I listened. My next problem was to find out what frequency and times to monitor the band for SSB or CW activity. Once I knew the best times to monitor for things like Sporadic-E, I really got into the band and it grew on me. But I saw that there was really a great void in written material that could help one get started on The Magic Band. Until now. My hope is that this book makes the transition for newcomers as smooth as possible. This is my wish for those who read this book and want to get started on Six Meters, The Magic Band.

Chapter 2
The Spectrum

The spectrum of 50 to 54 MHz has been allocated for amateur use since 1946 after the FCC moved Amateur Radio operators from the Five Meter band. During the early years of Six Meters, there were only three basic modes used on the band, AM, CW and radio control. Most of the activity took place around 51 MHz. There was no comprehensive band plan used, as it was not really required. Since that time, with the introduction of a number of new modes of operation, the need for a structured band plan developed. The band plan was developed by the ARRL and other radio organizations for this 50 to 54 MHz spectrum. It has been agreed to and followed by the majority of the hams who use The Magic Band. Figure 2-1 provides a graphic of the ARRL band plan for the spectrum as adopted for use in the United States and other areas of the world. The plan can also be found in the ARRL Repeater Directory.

By international law, the band section from 50.0 to 50.100 is reserved for CW only. In this spectrum from 50.000 to 50.100, you will hear a number of beacons when conditions are right. The automatic beacons in North America are generally located in the 50.060 to 50.080 range, whereas international beacons span the range of 50.020 to 50.080. These beacons are low-power signals that provide useful navigation aids to let hams know when band openings occur. Typically, they are unattended stations that have simple keyer circuits running five Watts or less. A simple antenna such as a vertical is used to cover all directions. Many times one will hear a faraway beacon on Six and no activity on the band! This is a particularly frustrating experience due to the fact that openings are not a routine thing. By the way, another frequency to monitor is 28.885 which is used by Six Meter operators to set up schedules on Six or to find out what is happening on The Magic Band.

CW is used on Six Meters, particularly when signals are weak. It will generally be found in the area of 50.080 to 50.100. More often than not, it will be found just above 50.1, particularly during a contest. Though the Six Meter band is occupied by a large percentage of Technician licenses, it does not necessarily mean that they cannot copy CW or that CW operation is frowned upon. It proves very useful to be comfortable with this mode even if one does not have to use it on a regular basis. For example, an Aurora opening on Six Meters will distort phone signals and CW is very useful when this occurs. Also, CW is used for Six Meter QRP work and meter scatter contacts.

Beginning at 50.100 and ending at 50.300, is the sideband portion of Six Meters. As in the high end of the HF spectrum, upper sideband is the convention that is used on this band. Both sideband and CW are considered weak signal modes on Six Meters. Sideband is generally the more popular activity of all of the modes used on Six Meters. Although, in some areas of the United States, FM may be just as popular if not more so. In the sideband portion, there are a couple of designated frequencies that are used as calling frequencies. The frequency of 50.110 is reserved as the DX window for the Six Meter band. Here, U.S. stations can work DX stations during an F2 or double-hop Sporadic-E opening. Good operators avoid cluttering up this frequency by moving up in frequency once contact is established. The general calling frequency for stateside stations is 50.125. This is the primary frequency that all weak-signal Six Meter operators will leave their radio on when monitoring conditions in the ham shack. Usually hams will move up in frequency once contact is established but this is not strictly observed during the very quiet times.

The next block of frequencies, 50.3 to 50.8 is where any mode can be used. However, some convention has been established with the most common mode in this range being AM. That mode is particularly popular in certain areas of the U.S. late at night. Typical gear that is used here are converted commercial radios that are crystal controlled. AM groups will have what is known as activity nights which usually start at 11 p.m. local time or after, in order to avoid TVI complaints. AM and Six seem to go together as there's a lot of room on this band that can accommodate the full fidelity of an AM signal. The AM calling frequency that is generally used is 50.400. The AM mode is far from dead. It's kept alive on this band through the group of hams that use vintage AM radios. The portion of 50.6 to 50.8 MHz is usually set aside for non-voice communications with 50.620 MHz set aside as the digital calling frequency.

The next block of 50.8 to 51.0 is allocated for

radio control (R/C) use. R/C frequencies are set for every 20 kHz in this range. It is here that the two hobbies of Amateur Radio and radio control are united. Typically, radio control signals in this frequency are a series of tones used to control model aircraft, rockets and boats. For model aircraft these tones are used to operate the flight control surfaces. In model rockets, these tones are used for stage ejection, chute deployment and for retrieval search. In model boats, signals are received for rudder control. More on this fascinating hobby is in Chapter 11.

The next block of 51.0 to 51.1 MHz is designated as the Pacific area SSB and CW portion is 51.110. The Pacific DX calling frequency. This doesn't mean that you wouldn't see the possibility of Pacific DX down in the 50.0 to 50.3 range. What it does is to provide another area in the spectrum for Pacific stations for daily use and another window for hams from other countries that are not able to work DX at the 50.010 DX window.

FM activity is allocated between 51.1 to 54 MHz. The lower end of this portion is dedicated to digital repeater modes whereas the upper portion is dedicated for voice communications. The FM simplex calling frequency is 52.525. Repeaters in this range generally use a one MHz or a 500 kHz split for the receive and transmit frequency pairs. However, this can vary depending on what area of the country you are in. The repeater frequencies are conveniently listed in the *ARRL Repeater Directory*. In most areas of the country, Six Meter repeater activity is significantly less than the activity on Two Meters. This reduction in use is due to a number of reasons which will be discussed later on.

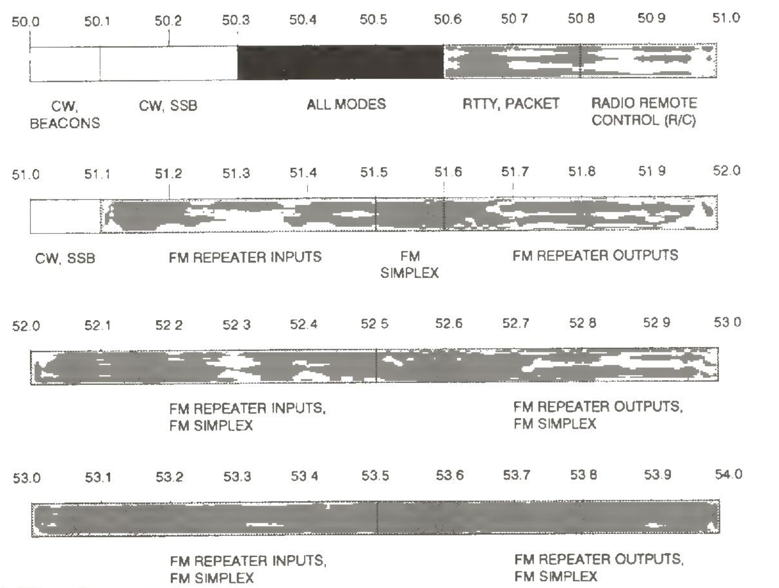
All U.S. license classes, except the Novice class, can operate on Six Meters. The lowest license class that can operate on this band is the Technician class, which includes both the no-code Technician class and the Technician Plus class. Maximum power output is the same as the HF bands or 1500W PEP output. However, FCC guidelines suggest that you use only the minimum amount of power that is required for two-way communication. The privileges are identical for all the license classes on this band with regards to power levels and frequency ranges. This was not always the case in the early days of Six Meters. Then, certain privileges were allowed depending on your license class. However, Six has been an "open" band in the U.S. and Canada for over two decades now. Even though there is a large population of Technician class licensees on Six, one will see all of the license classes there. Because the privileges are the same for everyone who can legally operate on the band, there is no class distinction or negative attitudes practiced in this regard.

In England, France, Germany and other European countries, there is a distinct VHF license class where code is not a requirement and only operation on the VHF bands is authorized. Some of the European countries have strict power level requirements due to potential RFI concerns. However, Six Meters allows these hams a chance to taste some DX work that they normally wouldn't find on the other VHF bands. A large and enthusiastic following is developing in these countries on Six Meters, primarily through this VHF class of hams who have been breaking new ground on this band.

Band plans may vary a little as you travel into other countries. But, by and large the basic philosophy is kept the same. Certainly, the lower band edge is used primarily for weak signal work such as CW and SSB, and there is general agreement to this worldwide. One will find the majority of international communications done in this area as discussed in a later chapter.

Figure 2-1

THE SIX METER SPECTRUM



Calling frequencies:
SSB DX 50.110 and 51.110 MHz
SSB: 50.125 MHz
FM Simplex: 52.02, 52.04, 52.525 and 52.54 MHz

Chapter 3
Kaleidoscope Of Propagation

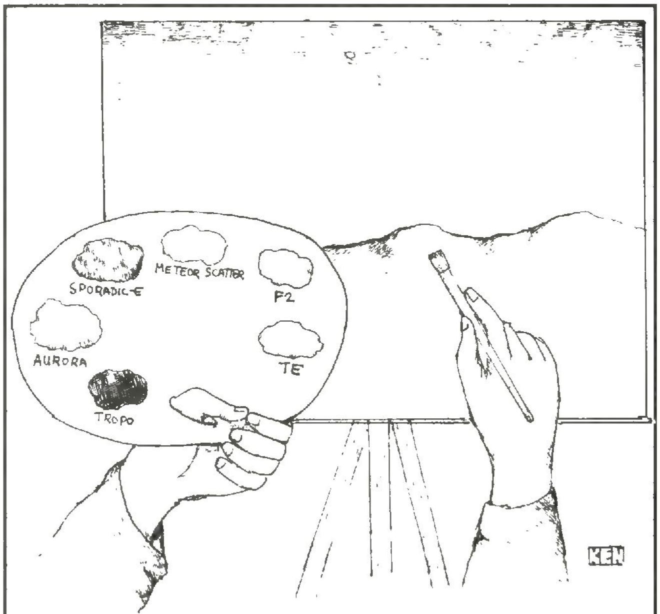
More than any other Amateur Radio band, myriad types of propagation can be found on Six Meters. This is the beauty of the band, the fact that you will find much greater pronounced effects that is seen on the other bands for Sporadic-E propagation as well as meteor scatter work. Each of the major propagation modes such as Sporadic-E, Aurora, Meteor Scatter, Transequatorial and F2 represents a different color in the kaleidoscope of propagation. It seems that Six Meters provides the best canvas in the radio spectrum for operators to enjoy these wonderful and interesting forms of propagation. Very distinct things are experienced on the band when they occur with each mode having its own unique trademarks that allows experienced operators to identify them. These forms of propagation can appear throughout the entire Six Meter spectrum. But, it is mostly in the weak signal modes of SSB and CW where they are noticed the most. We'll now look at each of these modes.

Sporadic-E

The most common and pronounced mode that is found on Six Meters is Sporadic-E propagation (designated as Es). Although it will be found as low as 15 Meters its name seems to be most synonymous with the Six Meter band. This is also the most misunderstood phenomenon in radio today and this is reflected in the relatively sparse amount of literature that exists on it. In simple terms, it can be described as a cloud of charged ion particles that appears in clusters at random in the E-layer of the ionosphere, located 60 to 70 miles above the earth. These ion clouds vary in length and width and generally are no more than a few-thousand yards thick. Sporadic-E is fairly common during the summer months of the temperate zones (the areas from 20 to 50 degrees latitude, north and south) with propagation occasionally lasting until midnight. In the northern hemisphere, the active months are May, June and July. It also will pop-up on occasion during the winter months of November, December and January but openings will occur with less frequency and be of shorter duration than during the summer season.

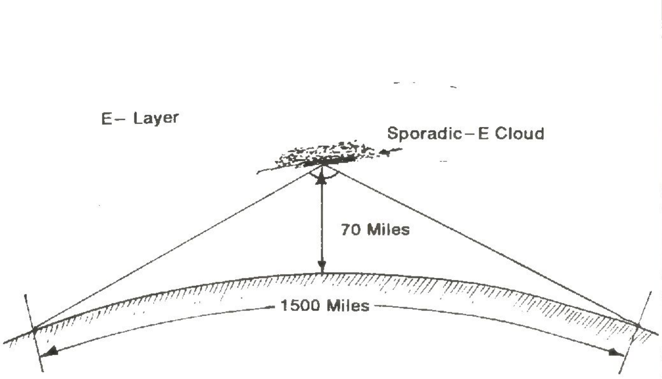
When Sporadic-E skip is present on Six Meters, the normally quiet CW and SSB portion of 50.1 to 50.2 MHz starts jumping with activity of unbelievable proportions. It's hard to describe the excitement. It can best be compared to fishing for bluefish when the frenzy of a large school that is in active feeding is speeding by for a period of only 20 minutes or so. Sporadic-E is unpredictable as far as time, duration and what day it might occur. You can't easily make a set of propagation charts to predict when and where Sporadic-E skip will be present. Signals will be very loud at times during an opening. Many stations will be running less than 50 Watts output and using modest antenna setups. Es activity is worked mostly in the CW and SSB portion with occasional activity occurring in the AM phone portion and on the FM simplex frequencies. Until one has experienced this phenomenon on Six Meters, you cannot truly say that you are a complete Six Meter operator.

Distances covered by Sporadic-E propagation can be as much as 1,500 miles with a single cloud. See Figure 3-1 for the pictorial description of the angles involved. It is also not unusual for two clouds to be present in different areas such that double-hop skip can occur and distances of over 2,000 miles may be achieved. Double-hop E allows for stations in the United States (East Coast) to work Europe during the summer months. East to West coast QSOs are also possible. There is no distinct pattern for which direction that stations should point their antenna to when listening for an Es opening. On very active days in June, there



Painting the Six Meter canvas

Figure 3-1



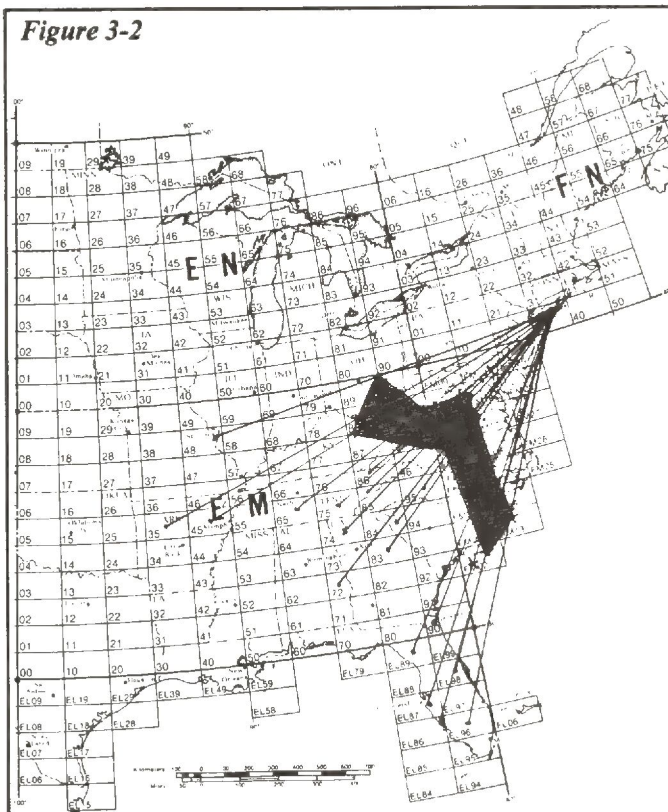
This is a graphical representation of the maximum distance that can be obtained with a single Sporadic-E cloud in the E-layer of the ionosphere. Maximum distance that can generally be reached with one Sporadic-E cloud is about 1,500 miles corresponding to a 160° angle of incidence that is measured between the entrance and exit trajectory into the Sporadic-E cloud. Typically, the angles and distances are smaller for most observations on Six Meters. An interesting observation—when these distances are shorter than normal (500 miles or less) on Six Meters, one can look for possible Two Meter openings due to the mathematical relationship between frequency and angle of incidence.

could be several clouds roaming about. On a June day in 1993, I worked CT1EZ in the Azores on a double-hop Es skip. Four hours earlier, I had worked into Florida. That is at least three clouds accounted for in one day! Typical Es QSOs for me at my QTH in Long Island are to the south and the midwest where distances average about 1,000 miles. Daytime and evening Sporadic-E openings are relatively common during the summer months with some intense openings lasting until midnight. Midnight seems like the natural dividing point between consecutive days of Es openings as there is seldom any Sporadic-E activity in the early morning hours of 1:00 to 5:00 a.m.

There are many ways to detect Sporadic-E propagation. One way is to continuously monitor the lower part of the band (50.0 to 50.1) for the many Six Meter beacons located there. Check current listings in the front matter of the *Callbook* or the *ARRL Repeater Directory* for the frequencies to monitor. A proven way to find Sporadic-E propagation is when cross-channel interference shows up on TV sets (using antennas) on Channel 2 or 4. TV stations from other areas will pop in and out when Sporadic-E is present on the TV frequency range of 56 thru 100 MHz. Sporadic-E is also present on HF. So when you hear "short skip" propagation of 200 to 300 miles on 10 and 15 Meters, it's a good time to check Six Meters for an E opening of even greater distances. As one becomes more experienced on Six Meters, it will be possible to detect an upcoming opening on a quiet band when the "charging" sound is heard. This sound resembles ignition noise and indicates activity in the E-layer. It climbs up in frequency and veteran Six Meter operators know that it usually precedes an opening by 10 or 15 minutes.

It must be pointed out that it does not take a "super" station setup to make Sporadic-E contact. Quite the contrary! Whenever a decent opening occurs you can make Sporadic-E contacts using just 10 Watts and a dipole. You'll be pleasantly surprised when you find that the 5/9 plus signal on the other end is using just 10 Watts. Sometimes medium power outputs of 100 to 200 Watts are needed when there is a marginal Sporadic-E opening or a double-hop Es skip. But, one can run 10 Watts the majority of time with good results. This is because of the high efficiency of the Sporadic-E cloud reflection, especially near the Maximum Usage Frequency (MUF). In this regard, Six Meters is a lot like Ten Meters during its peak time. When conditions are great, it does not take much power to put out a decent signal. It appears that Six Meters is the best amateur band on which to observe Sporadic-E. Ten and Fifteen

Figure 3-2

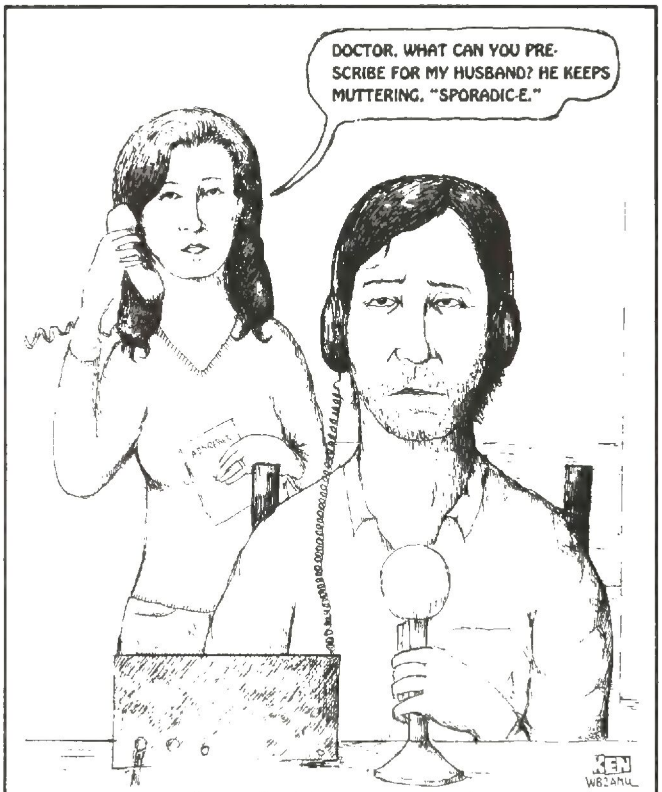


A Sporadic-E cloud mapping using contacts made by WB2AMU from FN30 during the first hour of the 1993 June VHF contest. This particular Sporadic-E opening lasted over three hours before the cloud dissipated.

Meters has it often, but it is often covered up by other forms of propagation. Es openings happen on Two Meters, but only during intense activity. Typically, for most locations in the temperate zones of the earth, an operator may see one Es opening on Two Meters for every eight Six Meter Es openings. This would mean less than five Es openings on 144 MHz on a yearly basis as compared with greater than fifty openings on Six Meters. Six can truly be called the "Sporadic-E band." If you take away Sporadic-E, Six Meters becomes a much less interesting band.

Part of the fun in working Sporadic-E contacts is that it is possible to map the approximate size and location of a Sporadic-E cloud. Use a map and connect a line between the various stations that contact each other during such an opening. The midpoints of these lines are plotted and the general shape of the cloud can be determined. This can be done because in most cases, the angle of reflection of the radio waves bouncing off the cloud having an equal entrance and exit angle. This data is more accurate when such an opening occurs during VHF contest as a great number of data points can be used, not only at your station but all of the others stations as well. From your own station you can create such a mapping with fair accuracy. Figure 3-2 shows a mapping of a Sporadic-E cloud from my QTH during the first hour of the June, 1993 ARRL VHF contest. It is important to realize that this mapping gives the general location of the Sporadic-E cloud or group of clouds and is more accurate with each additional contact as a data point. Also, it must be noted that the cloud is moving so plots should be done in intervals of around 30 minutes or so in order to get a fairly good plot. Also some hams prefer to put an ellipsoid around the midpoints but this doesn't imply any more accuracy. Remember, the E-cloud is irregular in shape.

Duration of Sporadic-E openings vary for each opening. Openings can be as short as two or three minutes to as long as ten hours! During very intense openings during the summer months, it still pays off for the operator to keep monitoring the band even when conditions drop out. This is because the ions in the Sporadic-E cloud may be in such a high state of activity that even after dissipating, the cloud may reform some time later. Never give up completely after a Sporadic-E opening fades. Check the band again a little later. This happens often during the various VHF contests that take place in the summer.

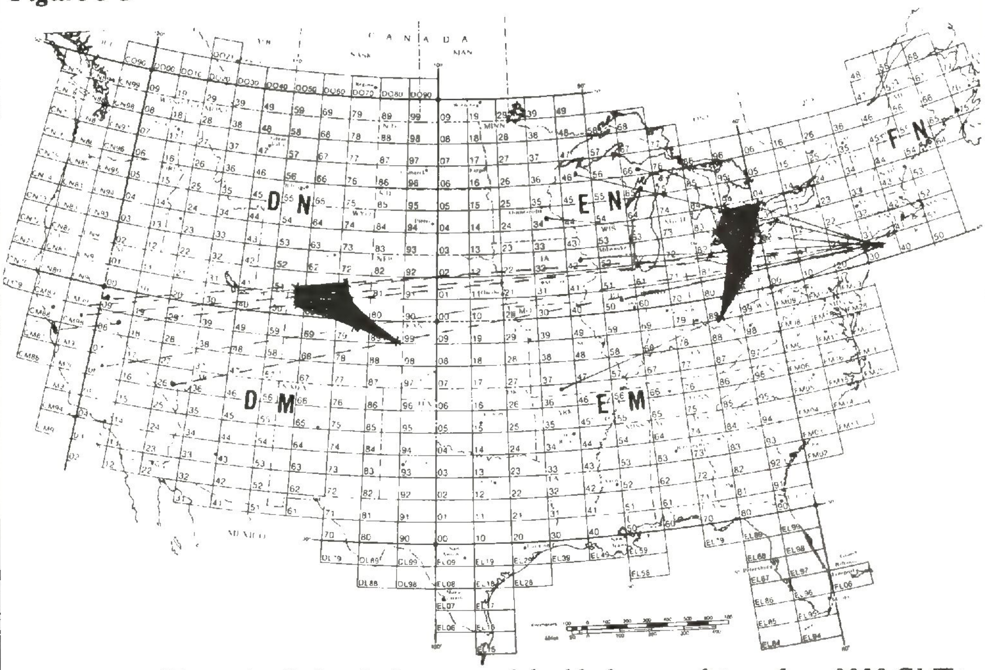


Sporadic-E is contagious!

In general, unless it is an intense opening, it pays to keep QSOs short and to the point because there is no way to really know how long the skip will last between you and the other station. When double-hop Es is present, it is almost mandatory to keep QSO crisp and short because now you are dealing with two Sporadic-E clouds between you and the other stations. Typically, a double-hop Es skip lasts less than 10 or 15 minutes and they represent a chance for stations to work some real DX, particularly during low sunspot count years when F2 is gone. I have been able to work double-hop Es to the west into Arizona and to the east into Europe during the heat of the June Es season. On rare occasions, three or four hop Es QSOs have been accomplished.

Observations that have been made on Six show that Sporadic-E propagation is independent of the sunspot count and will not decrease in frequency of occurrence during the sunspot cycle minimum. Hence, one should not listen to the uninformed and put the Six Meter rig away when the sunspot count goes down as Sporadic-E events will still occur. Some claim that Sporadic-E activity seems to pick up during the sunspot minimum. Double hop Es contacts make long range DX still possible even during the sunspot minimum. Remember, Es events take place because of activity in the E layer of the ionosphere and this is independent of F2 layer propagation which relies on the sunspot count. In fact, there is belief among Six Meter operators that Sporadic-E is

Figure 3-3



A mapping of Sporadic-E clouds that created double-hop conditions from 0030 GMT to 0130 GMT of July 14, 1993. This mapping plotted stations that were either contacted or heard from the QTH of WB2AMU, Long Island, NY (FN3Ø).

especially intense during the summer months of average sunspot count years. I have found this to be true from my own observations on Six Meters for the months of June and July for the years 1992 and 1993. The number of days for which I heard Sporadic-E openings doubled even though the sunspot count decreased from a high level to an average level. I had also noted a pronounced increase in the number of double-hop Sporadic-E openings during the summer of 1993. See Figure 3-3 for a mapping of one of these double-hop Es opening that I observed in July of 1993. Based on the observations on Six Meters it does not appear that sunspot count is a direct factor on Sporadic-E propagation.

There are several theories as to how Sporadic-E clouds are formed. These have stirred up much controversy, particularly on Six Meters. Some current theories suggest that Sporadic-E is tied either to thunderstorm activity, windshear motion or to geomagnetic activity. However, these theories have poor correlation to fact when trying to explain the origin of the E-clouds as well as trying to explain how there are two distinct seasons for Sporadic-E. In addition, scientific measurements have determined that the composition of these clouds consists of metallic ions such as iron and magnesium and these theories do not explain how they originally arrive into the E-layer of the atmosphere. The sad irony about these investigations into the causes of Sporadic-E is that it was a form of propagation that was immediately observed when hams first populated the Six Meter band in 1946 and there are still too many unanswered questions. Part of this is because some studies did not look at the factors that cause the seasonal pattern of this phenomenon. It appears more and more that the phenomenon is affected by other factors that are related to activity from the sun. Chapter 10 will look at the causes of Sporadic-E in more detail and describe how the sun is possibly a major factor in this phenomenon.

Aurora

Another unique type of propagation found on this band is caused by the effects of Aurora in the E-layer of the ionosphere. Aurora propagation, designated as Au, occurs on VHF in the mid-latitude areas of the earth when there are intense periods of geomagnetic activity, usually after a solar flare occurs. At latitudes above 60 degrees, Aurora is a common occurrence and hence the areas around the magnetic north and south poles are designated the Aurora zones. The famed Northern Lights seen in Canada and Alaska are the visual manifestation of this phenomenon.

When an Aurora opening occurs on Six Meters, signals will have a distinct sound where distortion will make them sound watery. Voices will sound garbled, so CW is the most effective mode during such an event. Aurora events on Six Meters may cover more than 1,000 miles and skip tends to be towards the north. Contacts between the east coast of the United States and Alaska are not uncommon during a good opening. During such an opening, it is possible to work those stations three or four grid squares away which normally cannot be worked by ground-wave or Sporadic-E. Openings become scarcer as you head toward the equator from either north or south. As in Sporadic-E, Aurora events are also not possible to predict. Events occur at a lesser rate than Sporadic-E openings in the mid-latitude ranges of the earth, so it is hard to determine if any seasonal patterns can be determined. However, monitoring WWV for a high daily Kp index reading is one way for an operator to get a jump on any

Aurora openings that may occur. Openings may last, on average, over an hour, but there have been some recorded openings that last almost a full day.

Like Sporadic-E, it does not take any special station to be able to make Aurora QSOs. Generally, it takes a modest amount of power in the range of 100 Watts or more because of the fluctuation in the signal quality and strength. Also, being a good CW operator helps because this is the recommended transmission mode for making Au QSOs because of the high distortion of the signals.

You can plot the location and size of an Aurora cloud the same way that you can plot a Sporadic-E cloud. The method is identical as you would draw lines between stations and plot the midpoints which are going to be in the same location of the cloud. There is no rule of thumb as to how long an opening will last. Generally an intense solar flare which registers over 9 on the Kp index scale could cause an opening several hours long. A day-long event is not unusual, particularly as you go higher in latitudes toward the poles where these events are more frequent. Aurora events are more common as you travel closer to the magnetic poles. In areas immediately around the poles, Aurora is a year-round phenomenon. In areas that are in the borderline region between the earth's Aurora zone and the temperate zones, such as the middle part of Canada and England, it is not uncommon to see up to a dozen good openings during the course of a year. It is important to note that Aurora openings can take place any time during the day. In fact, there have been several openings that have sprung up during the pre-dawn hours. Unfortunately, these are not always taken advantage of, except by good operators who monitor WWV for daily geomagnetic readings that indicate that a magnetic storm is brewing.

The cause of Aurora propagation is directly linked to the interaction of solar ion particles ejected from the sun with the earth's magnetic field. This has been visually proven by Skylab astronauts when solar flares resulted in an Aurora formation in the earth's E-layer. Aurora and Sporadic-E propagation are closely related more than some hams realize. A more in-depth look will be provided in Chapter 9.

F2 Propagation

Another form of propagation found on Six is F layer propagation, also know as F2 skip, which shows up during the years surrounding the sunspot maximum of the 11-year cycle. This too, cannot be predicted too easily by propagation charts as can be done with the HF bands except for during peak sunspot conditions. With the continual improvement in propagation prediction via computer software, better methods of predictions will be available for the next sunspot maxima that will occur by the turn of the century.

Strangely enough, when peak conditions show up on Ten Meters during the maximum years in September and April, it is rare that Six is open for F layer propagation at the same time. Instead, it lags about a month later, usually in late October and sporadically throughout the winter months. This situation may be attributed to the changing nature of the F layer during that time along with the factor of how high the Maximum Usable Frequency (MUF) is able to climb. It is possible for stations to work all continents during a winter season with a relatively modest station setup when there is F2 skip. Skip openings are not too long in duration, so careful planning is required for listening time. A European opening to the Eastern United States may last for a half-hour and not always at the same time of day. A good rule of thumb as suggested by VHF expert and writer Emil Pocock, W3EP, is to listen when noon arrives at a midpoint location between two different areas. For stations on the east coast seeking to work Europe, this would mean monitoring the band between 9 and 10 a.m. local time as noon would be over the midpoint or the Atlantic ocean.

When F layer propagation is hot, you will notice more pileups than normal on Six Meters. Fortunately, it is not impossible to break these pileups because usually the zone of coverage is smaller than on the HF bands. For example, an opening between parts of South America and the United States would generally be between one section of the United States into one section of South America. It is important to note that modest power levels of 100 Watts output using this propagation will be successful the majority of the time. This is because of the strong propagation that this mode can sometimes generate and also because there is less QRM on the Six Meter band in comparison to the HF bands.

From these examples, it can be seen that Six Meters requires daily monitoring for those hams who are chasing DX or looking for a Sporadic-E opening. This style of listening is a time consuming process that borders on obsession as the band is quiet better than 95 percent of the time. Extreme patience is required. However, one open-

ing will pay big dividends. Unfortunately, some hams will mistakenly lose interest in Six Meters when the sunspot count goes way down. They mistakenly will not monitor the band any more even though Sporadic-E propagation will still continue.

Meteor Scatter

Meteor Scatter is a major propagation mode for Six. The casual observer may never come across meteor scatter contacts by accident, except during periods of peak activity. Sometimes, during a VHF contest, you may hear the callsign of a station located several grid squares away that is popping in and out. This type of situation could be attributed to meteor scatter only. I've had limited experience with meteor scatter work on Six, having worked a few stations during major shower activity. So, I have asked my friend, Larry Jones, WB5KYK, who is a well-known expert on the subject to write on this subject at this time. Larry conducts many meteor scatter schedules on all of the VHF bands as well as Six Meters from his QTH in Laurel, Mississippi.

Larry writes, "Six Meters is the band for meteor scatter propagation. Basically, meteor scatter exists when a meteor(s) enters the ionosphere and leaves a column of ionization behind it. This ionized column lasts for a brief period of time, normally seconds. The greater the number of meteors that enters the ionosphere, the more ionization. Meteor scatter is useful for two main reasons: one, it is not dependent on the sunspot cycle and two, it is highly predictable. The serious 50 MHz operator will learn to use meteor scatter and he will work stations when there is no Sporadic-E, F2, etc.

"What kind of equipment does it takes to regularly make distant meteor scatter contacts? A beam antenna is needed. A three-element beam will allow you to make some contacts. A five-element beam will allow you to make regular meteor scatter contacts and a six-element beam will allow you to become a serious meteor scatter operator. Any additional element will make the beamwidth too narrow. Avoid antennas with narrow beamwidths. Your antenna won't "see" enough of the sky and will miss some high ionization and this is the ionization that is useful for really long distance work. Antennas are the curse of meteor scatter operators. We want high gain but we must have a wide beamwidth to work the really long haul contacts. Use the best feedline and connectors that you can afford! Use nothing with more loss than 9913 cable. It's that simple. Antenna height depends on your location. If your location is free of obstructions and you have a clear view of a distant horizon, your antenna should be between 30-feet to 50-feet high. This height will help you get a wide beamwidth. You must get your antenna above obstructions so it can "see" a distant horizon. High antennas are great for tropo, Sporadic-E, F2, radials etc., but do not work as well as the lower antennas for meteor scatter. The most serious stations go to great length to achieve good ground conductivity around their meteor scatter antennas by using a large supply of radials.

"Mast mounted pre-amps will open up a new world to the meteor scatter operator. You can work scatter without them. But, once you get accustomed to using one, they are hard to live without! Use a sequencer device. Both pre-amps and sequencers are available commercially. Strive for a pre-amp that has a low noise figure (NF). Once again, a mast-mounted pre-amp is not necessary for meteor scatter but if you are serious about this mode of propagation, you will sooner or later get one!

"How much power do you need for meteor scatter? Simply put, the more the better! But don't let that statement scare you, for 100 Watts into the right antenna will give you very good results, a 150 Watt brick will give you a very reliable power level and if you run 500 Watts or more, you are a big gun in meteor scatter work. I frequently work 10 and 25 Watt stations.

"A multi-mode transceiver is needed for meteor scatter work. Most meteor scatter work is done on SSB but CW is showing up more and more on long haul contacts. A filtered speaker is very helpful. Be sure your transceiver is on RIT during receive as Doppler shift is very much present in long distance meteor scatter. Never change your transmit frequency. It is very helpful to have a frequency counter to precisely set your transmit frequency but this is not mandatory.

"How do you find someone to work on meteor scatter? Meteor scatter operators work random or via schedules. Around 1200 UTC, there are a lot of random signals heard on 50.125 MHz, especially on Saturday and Sunday mornings. Meteor scatter operators transmit on certain time intervals. The eastern-most stations transmit the second and fourth 15-second intervals of each minute. The western-most stations transmit on the first and third segments of each minute. Never, never deviate from this sequence, otherwise both stations will be transmitting at the

same time. This sequence is standard meteor scatter practice. Random meteor scatter requires patience, patience and some more patience.

"The best way to run meteor scatter is by schedule. There are a number of VHF/UHF newsletters that contain information pertaining to stations that you can contact for a meteor scatter schedule. When you contact the desired station by phone or mail to set up a schedule, the following must be mutually agreed on:

"1) DATE — Schedules are normally made for meteor showers. Minor and major showers give good results on 50 MHz. A number of sources list meteor shower dates. A list of major events is provided at the end of this section.

"2) TIME — The best time for 50 MHz schedules are shortly after sunrise, your local time. Most schedules are set for 30 minutes on 50 MHz. Be sure each station understands which 15 second segment of the minute he will use to transmit. Be sure your clock is set to WWV before beginning a schedule.

"3) FREQUENCY — Stay well clear of 50.125 for meteor scatter schedules. I normally run my meteor scatter schedules on 50.140 or higher. Be sure the frequency is clear of "birdies" at both stations.

"4) PHONE — Be sure that both stations have the other's phone number and understand that they will be notified if the other can't keep the schedule (that does happen).

"5) EXCHANGE — Most exchanges on 50 MHz meteor scatter are either a grid square locator or else an "S" number indicating the length indicating the length in seconds of the meteor burst. Most of the time stations use "S2." You must speak very rapidly in meteor scatter work and avoid extra words! A valid meteor scatter contact consist of at least an exchange of both callsigns, reception of a report or grid square and an acknowledgment of information received.

"6) BEAM HEADINGS — Finally, be sure of each other's beam headings. It is also nice to know the distance.

"The question now is: When do showers occur? There are several sources to find out when a shower occurs. These include the propagation section of radio magazines, newsletters, books on the subject and meteorological associations. See the Appendix for a listing of these references.

"The best way to know when to schedule meteor scatter contacts is to keep accurate records. When you learn there is to be a meteor shower, run your schedules a day before the predicted peak, the day of the peak and a day after the peak. Run your longest distance schedule the day before the peak and your shortest schedule the day after the peak.

"How far can you work using 50 MHz meteor scatter? The best answer is that I don't know. That record hasn't been set and there is no DX record for meteor scatter on 50 MHz. The belief is that past 1,200 miles, other propagation is used to get the signal to the other station (such as tropo or Sporadic-E). But remember, it was meteor scatter that got the signal to the location where

Table 3-1
Listing of the Major Meteor showers

Name	Dates
Quantrantids	January 1 - January 6
April Lyrids	April 19 - April 24
Eta Aquarids	May 1 - May 8
June Lyrids	June 10 - June 21
Ophiuchids	June 17 - June 26
Capicornids	July 15 - August 15
Iota Aquarids	July 15 - August 25
Perseids	July 25 - August 18
Chi Cygnids	August 19 - August 22
Orionids	October 16 - October 26
Taurids	October 20 - November 30
Cepheids	November 7 - November 11
Leonids	November 14 - November 19
Geminids	December 7 - December 15
Ursids	December 17 - December 24

some other mode of propagation could take over! Without the meteor scatter part, the contact couldn't have been made. When this condition exists you will hear the distinctive loud burst of signals that for brief periods that tells you that meteors are at work!

"Meteor scatter has been around for a long time but we are still learning about it. Meteor scatter is an ideal way to enjoy the 50 MHz band all year round, regardless of the sunspot number!"

As a further input to Larry's words, I have been able to work a number of meteor scatter contacts on Six during non-scheduled operations. The contacts were made during intense meteor showers such as the Perseids in August when there are many stations listening, just like in a contest event. In fact, many VHF operators take some vacation time during the Perseids, in order

to complete meteor scatter contacts. During such strong meteor scatter openings, stations can jump up to 5 by 9 signal strength for about 15 to 20 seconds and then drop out completely, never to be heard from again. The duration of these signals corresponds with the burn rate of the meteor particles in the earth's atmosphere. Quick exchanges are required on phone to complete QSOs. Sometimes as in the case of August 1993, the Perseids coincide with a Sporadic-E opening, and it can be difficult to distinguish between the two propagation modes. Any QSO lasting more than a minute is probably not a meteor scatter QSO. However, even a Sporadic-E signal may show some variation in strength due to the effects of a meteor scatter opening.

Tropo

Tropospheric ducting can also occur on Six and this is caused by abrupt changes in the refractive index of the atmosphere at the boundary between air masses of different temperatures and humidity. Essentially, the denser air at the ground level slows down a front more so than the upper air levels, thus inducing a downward path for wave travel. Ducting occurs often when a large mass of cold air is overtaken by a warm air mass. This phenomenon is known as temperature inversion. Radio waves can actually travel several hundred miles in the boundary region between the cold and hot air mass.

Tropospheric ducting is common along coastal areas because of the temperature difference created between the quicker cooling of the ground air versus the slower rate of the upper air. Tropo is observed more on Two Meters than Six for the most part. On a trip to southern California, I heard a 28 Watt beacon from Mexico on Six Meters that was over 200 miles away. This was a classic Tropo opening which is common in the warm areas of southern California. However, during certain times of the year such as September, it is possible to work stations over 500 miles away via this mode on 50 MHz. In fact, the ARRL September VHF QSO Party seems to benefit more from this mode at this time of year as other modes such as Sporadic-E. Aurora contacts are virtually nonexistent then.

Transequatorial Propagation

Transequatorial or TE propagation allows stations just above the magnetic equator to work over the equator, thousands of miles south. It is caused by a highly ionized distortion that exist in the ionosphere over the magnetic equator. Radio waves that enter in this area at certain angles are reflected over considerable distances without the benefit of ground reflection. TE occurs primarily at night with darkness arriving at the midpoint between the two stations in contact via this mode. Signals must cross the magnetic equator in a north-south direction in order for TE to take place.

TE is not an uncommon form of propagation for Six Meters. Stations such as Luis Frederico, CT1WW, in Portugal have been able to work into South Africa, South America and even Japan via this mode. Tom Glaze, KC4SUS, in Miami, Florida, has been able to work into Argentina during the late months of January and February. A number of the stations that he has worked such as Andres Capelle, LU1EK, use less than 10 Watts and are perfectly readable. On occasion, stations at higher latitudes work stations on the other side of the equator via TE but this requires a Sporadic-E opening to be present to link up to the TE opening.

Ground–Wave

True, ground–wave or line-of-sight communications is not anything that is unusual but it is important to note this activity on Six. Most of the HF bands have some ground-wave capabilities, usually up to twenty miles. On Six, it seems that 20 to 30 miles on ground-wave is standard with greater distances being possible on most occasions. Low power will work the majority of the time. A number of hams are interested in the ground-wave capabilities of this band for a lot of reasons. There is a great expanse of space for one to carry on a local QSO. There is none of the QRM that is present on the HF bands or Two Meters, so even weaker signals can be heard in my area. I have seen a number of hams carrying on weekly schedules on this band with hams one state away. Many hams do not realize it, but Six is probably the best band for ground–wave work because of the distances that can be covered and because there is less QRM on the band.

In this mode, height and polarization of the antenna is very important. Stations that are on higher ground will have a noted advantage for line-of-sight work. By having the antennas on both stations using the same polarization, either vertical or horizontal, there will be less signal loss. A station using a vertical antenna could experience a loss of one or two S-units from not using a horizontal antenna when working another station that is horizontally-polarized. As a rule of thumb, the majority of the home stations

on Six Meters are horizontally-polarized with mobiles stations generally vertically-oriented unless they have a halo type antenna.

As part of this mode, a phenomenon known as knife-edge diffraction can take place where an obstacle such as a mountain may enhance the distance of a ground-wave by diffraction of a VHF wave traveling over the crest of the mountain. It is interesting to note that police bands near 50 MHz work well for local work even when riding in mountainous terrain.

In summarizing the various propagation modes, it must be pointed out that there are some days when a number of these modes may appear at the same time. It is not uncommon for a meteor shower opening toward the north to occur at the same time as a Sporadic-E opening to another direction. Some long-range DX has been the result of F2 to Es openings occurring simultaneously. Aurora and TE likewise may show up at the same time as Es. So be alert when listening on The Magic Band!

Chapter 4
Magic Band Gear

It isn't easy to find affordable Six Meter gear when you are starting out. If you choose to search for used gear, it must be realized that even though there have been many different models throughout the years, production runs of many models were limited and the current demand is higher than the supply. However, there is some used gear that can be found and can represent an inexpensive way to get started. It is amazing the amount of vintage radios that are still in use on Six. It's not unusual that some of the stations that you work will be using vintage gear that is over 30 years old. If you're looking to buy newer gear, it is important to note that recent HF rigs now have optional versions that includes Six Meters. They employ current state-of-the-art technology and this may be a practical option if you are already in the market to upgrade your HF setup. We'll now look at the 50 MHz transceivers, starting with the vintage models that came out during the days when Six was very popular.

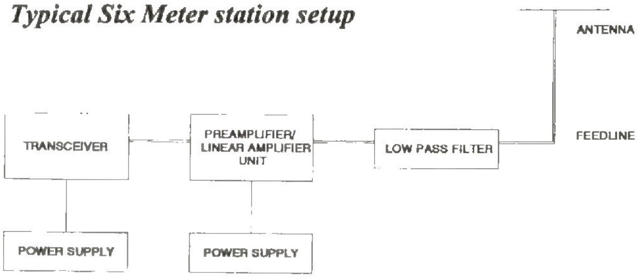
Looking back at the large quantity of commercially-made Six Meter transceivers from the 1950s and 1960s in comparison to the quantities being made currently, one can see just how popular this band used to be. As one examines the old advertisements of now-defunct companies, one can be amazed at the diversity of transmitters, receivers and antennas that came out for Six. The majority of the gear that came out at this time was built in the United States. This was the peak for the U.S. electronics industry with companies like Clegg, Gonset, Ebco, Hi-Par, Swan and Polytronics leading the way in the manufacture of 50 MHz gear. Unfortunately, these companies no longer exist but their radios still show up at ham radio flea markets. They represent either nostalgia to some hams or a cheap way for others to get started on Six.

Gonset and Clegg put out a number of different models during this time. Some hams consider Clegg to be the Cadillac or the "Collins" of 50 MHz gear while others avoid it. It depends on the model. Clegg put out several SSB/AM/CW transceivers such as the Sixty-Sixer, the Ninety-Niner, the Venus and the Thor VI. Clegg also made individual transmitters and receivers such as the Zeus transmitter for AM and CW and the Interceptor receiver. The top of the line models were made to a high level of quality and workmanship. Clegg concentrated totally on VHF equipment while Gonset worked both VHF and HF. Gonset put out the Communicator IV, the Sidewinder and the GSB-6 Sideband Communicator. Power range was in the order of 20 to 100 Watts input and both of these companies put out linear amplifiers for the band. This included the Clegg Apollo 700 and the Gonset 903A. Some of this gear shows up at flea markets and depending on the condition, can command a high price from those who may be looking to collect them.

A common model that came out around 1965 was the Swan 250 transceiver. This rig includes the CW, SSB and AM modes and even had a VFO. Even though it is limited in some aspects of the design, it still represents a cheap and quick way to get on Six. The Swan 250 can be the most often of the older rigs found at many ham flea markets. This rig is well known for its notorious VFO drift and lack of internal calibration. The VFO drift was due to an unstable oscillator that used the third harmonic as its basic design, which is not considered very good design practice for VFO stability. About the only way to deal with this drift without going into major modifications is to turn the rig on about a half hour before you use it. By then the drift rate has slowed down so that it is tolerable. There were two later models with the 250C improving upon the original design. Power input is 180 Watts leading to a power output of around 100 Watts. You can generally find this rig for under $150 and this should include the external power supply. Be aware that this rig is not filtered for TVI prevention. You can modify the input filter on the power supply from a capacitance input to an inductive input by moving one of the capacitor leads to the other capacitor in order to reduce some of the TVI but in general this can be a losing battle with this model. The Swan could be used in a mobile configuration through the use of a special mobile power supply but this was a very bulky setup.

Other American companies such as Johnson and Hallicrafters were also in the market. Hallicrafters put out a 50 MHz rig in 1965 known as the SR-46 which was an AM transceiver that put out a little more than five Watts. It had spots for four crystals or for an external VFO connection. This rig featured an easy to remove snap-on cover for troubleshooting. Johnson put out an AM transverter at this time known as the 6N2 which

Typical Six Meter station setup



Here is a block diagram of a typical Six Meter station. Typical transmitter output would be 10 Watts for input into the linear amplifier. This diagram is a simplification from the old days when pre-amps, linear amplifiers, transmitters and receivers were all separate units, making for a more complicated setup.

transmitted on both the Two and Six Meter bands. Both of these rigs are scarcely seen at all today.

Drake joined the market in 1970 with the introduction of the TR-6 which has many of the features that the Swan 250 had and it is considered a solid rig. The Drake TR-6 featured 300 Watts PEP input for SSB and AM, and 260 Watts input for CW. The rig put out more than 100 Watts for the three modes, more than any other transceiver of this class. Like the Swan 250, it has an internal VFO, but this design is much more stable. Instead of multiplying the base frequency, it uses crystal mixing which has much greater stablity. The only drawback is that the range that is covered is 600 kHz which required the use of nine different crystals for the VFO oscillator to cover 49.5 to 54 MHz. The TR-6 also had an external jack for hooking up an external VFO which could be used for split-frequency operation. It is probably the first 50 MHz transceiver to employ this concept of split-frequency operation. The list price for the TR-6 was $600 and it probably would sell for only a couple hundred of dollars less than that in the current market. The TR-6 is considered a bona fide collector's item. The TR-6 is still being used by those who were lucky to get hold of one and is considered like gold among Six Meter operators.

There were a number of kits for the 50 MHz band during its heyday. These included the Heathkit SB-110 and the Knight-Kit TR-106 transceivers. The TR-106 was put out by Allied Radio in 1966 and for under $200, one could get on Six inexpensively by building this kit. The TR-106 is seldom seen at flea markets these days. The Heathkit SB-110 came out in 1965 and it was designed for CW and SSB only. It put out 90 Watts on CW and 100 Watts SSB. It was designed for use either as a base station or as a mobile right through a mobile power supply adapter. This rig was also fairly bulky for practical mobile use, especially when compared to the compact rigs of today. The SB-110 can still be found in the used market today.

There was a significant amount of homebrew gear that was built on 50 MHz during this time along with a number of converted commercial radios. A number of the homebrew rigs were developed from designs that were presented in the *ARRL Handbook*. Homebrewing was a viable option for many hams on Six because they were able to get the parts and build for a lot cheaper than some of the commercial models that were being offered. Consider that a number of the VHF rigs were priced at over $300 with Clegg equipment such as the Zeus transmitter starting at $559 list price. It could be seen that commercial rigs in this price range were beyond the economic means of most people, considering that the average weekly salary during this time was less than $200. Therefore, building your own rig was a viable economic option as well as giving you the satisfaction of applying your technical expertise. Homebrew rigs in this era used a 6146 tube in the final, using about 15 Watts input and were crystal controlled. Six Meter homebrew gear is very scarcely used anymore and used homebrew gear from 30 years ago may be found in junk boxes as it has no value other than nostalgia to those who may have built them.

Here is a word to the wise for when you buy used 50 MHz gear. You are very rarely going to find 20 year-old Six Meter gear that is in mint condition. It is very rare to find gear that was hardly ever used or in "out of the box" condition. It is up to the buyer to ask the right questions about the condition of the rig and whether it is worth the risk to buy "as is." Sometimes an honest seller will tell you what is wrong with the rig and may even give you his phone number for traceability purposes. A schematic would be highly desirable. But do not expect that the equipment will be in ideal condition, so bargain accordingly. Plan on the possibility that some repairs may be required.

Fortunately, most of the vintage Six Meter rigs are of straightforward design and they used standard parts that can be replaced. Replacing tubes will be harder to do as some searching at stores and flea markets may be required. Other components such as electrolytic or paper capacitors probably will have to be changed as these components do deteriorate with age. A telltale sign for

old capacitors is the presence of hum in the receiver. Tubular capacitors may also have to be changed. Certain companies such as Gonset used less than desirable components such as tubular resistors which do not age well at all. These resistors either change value or open up when power is applied. Replace them all with new carbon or wirewound resistors. Mitchell Lee, KB6FPC, has seen that there is a particularly troublesome carbon resistor in Gonset models that connects the plate supply and the AGC line that goes bad. Replacement of this resistor will improve signal sensitivity of the receiver.

Other suggestions from KB6FPC are to check the coils of older rigs for possible corrosion on the exposed enamel of coil wire. These will eventually break and they should be cleaned or resoldered. Check the wiring in the rig to see if the connecting joints are intact. In addition, some of the older rigs do run very hot. It would be a good idea to place a computer fan on top of the rig. The fan should be placed over the final output tubes and placed such that the cooling air is blown into the rig for maximum benefit. Keeping these tubes cool will go a long way towards extending their life as there is more thermal stress when they run hotter. Spray electrical cleaner on tuning capacitors and mechanical switches to ensure good contact. These are just a few of the things that can be done to repair and improve upon vintage radios. Some hams will substitute FET transistors for tubes with some additional circuit modifications. Certainly, there are many more things that others are aware of, so ask around for advice with regards to these older radios.

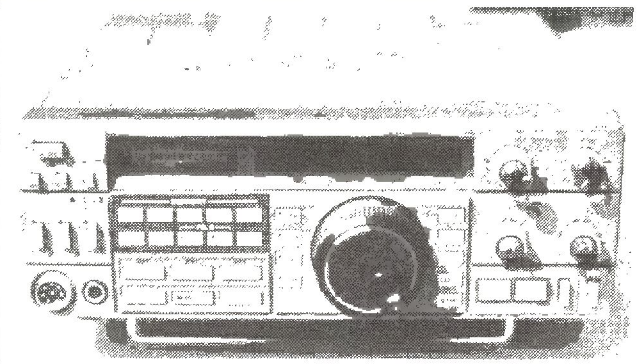
By the late 1960s, the big three from Japan, ICOM, Yaesu and Kenwood were in the market. A common model is the Yaesu FT-620 and FT-625 models which still can be found at flea markets or in ham radio stores at prices around $250. The FT-625 is better than the older model FT-620 as improvements were made in the audio and the display. This rig is popular because it has a built-in AC power supply as well as 12-Volt capabilities as in the HF FT-101 series. ICOM made the IC-502 and Kenwood marketed the TS-600 during this time.

The entrance of Japanese manufactured gear into the 50 MHz market represented a turning point for American-made gear. This influx of Japanese products would eventually spell out the end for many American electronics companies. The makers of Six Meter gear such as Clegg, Gonset and Swan would soon join HF radio manufacturers such as Johnson, Hallicrafters and National Radio. They would all become defunct by the end of the 1970s. It was not a quality problem that doomed these companies at the same time. After all, Gonset made the top-of-the-

Table 4-1

Listing of vintage American manufactured rigs (circa 1960s)

Company	Model	Type	SSB	CW	AM	Power Out
Allied Radio	Lincoln	Transceiver		X	X	5 Watts
Allied Radio	TR 106	Transceiver		X	X	5 Watts
AMECO	TX-62	Transmitter		X	X	40 to 50 Watts
Clegg	THOR IV	Transceiver		X	X	30 Watts
Clegg	"66er"	Transceiver	X	X	X	5 Watts
Clegg	"99er"	Transceiver	X	X	X	5 Watts
Clegg	Venus	Transceiver	X	X	X	40 to 50 Watts
Clegg	Zeus	Transmitter		X	X	100 Watts
Drake	TR 6	Transceiver	X	X	X	100 to 150 Watts
Gonset	Communicator IV	Transceiver		X	X	10 Watts
Gonset	GSB-6	Transceiver	X	X	X	100 Watts
Gonset	Sidewinder	Transceiver	X	X	X	10 Watts
Gonset	G-50	Transceiver		X	X	20 Watts
Hallicrafters	SR-46	Transceiver		X	X	5 Watts
Heathkit	SB 110	Transceiver	X	X		100 Watts
Polytronic	"62" B	Transceiver		X	X	5 to 10 Watts
Spectrosonics	Sidebander 6	Transceiver	X	X	X	10 Watts
Swan	250	Transceiver	X	X	X	100 Watts
Whippany Labs	Li'l Lulu	Transmitter/Receiver pair	X	X	X	5 to 10 Watts



The TS-60 Quad bander. This transceiver came out around 1984 and it features 10 Watts output on the 40, 15, 10 and 6 Meter bands. This class of rig was the predecessor to the current class of all-band transceivers that feature Six Meters as an option. —*photo by Ken Neubeck, WB2AMU.*

line equipment for bands like Six Meters. Rather, it was more of a question of economics that would cause the downfall of these American companies. It just became too expensive to manufacture high-quality radios in the United States. These companies were not able to compete with the manufacturing techniques of the Japanese and they would all vanish. The disappearance of Gonset and Clegg would particularly affect the popularity of Six Meters as there was no equivalent selection offered by the Japanese companies. There have been no American-made 50 MHz SSB transceivers in the last 20 years.

The next wave of commercial Six Meter gear made during the 1970s and 1980s, featured the ICOM IC-551 series, the Yaesu FT-680 and 690 series and the Kenwood TS-660 and 670 series. Here newer concepts that are employed included digital displays, lower power and FM mode for portable and mobile work. There were a number of companies such as Comtronix and KDK that made only FM rigs during this time period. Used gear from this era tends to hold its value well, usually only 200 dollars less than their original list price. A particularly popular model is the ICOM-551D which puts out 80 Watts and this rig still sells within $100 of its original list price.

The most recent phase is where newer rigs combine Six Meters in an HF transceiver package. An early version of this appeared in the Kenwood TS-670 quad-bander when it was introduced in 1984 and currently all of the major manufacturers make versions of HF rigs that also include Six Meters. The ICOM IC-726 and the Yaesu FT-650 and FT-736 are more examples. The new Kenwood TS-690 is a version that includes both HF and Six Meters and can still have the automatic tuner for HF put in the same package. This package will allow an HF operator who is upgrading his HF setup anyway, a chance to get started on Six at only a modest cost increase.

It can be difficult to find used Six Meter gear of 1980 vintage and for a reasonable price. A case in point is the TS-670 Quad bander. This transceiver covers 40, 15, 10 and 6 Meters with 10 Watts of power output. It has appeal to several types of hams: the Technician Plus ham, the QRPer and anyone looking to get started on Six. This rig cost about $600 when it came out in 1984 and it is still a hot rig. I could not find this rig, or a similar model, at any of the local flea markets. I spent six months calling 1-800 numbers of several Amateur Radio stores throughout the country before I finally located a used TS-670 in Arizona, which had just been traded in that day. A friend of mine, Alan Smith, K2BPQ, recently got the urge to get back on Six Meters after a long absence and could not find this rig anywhere for the better part of a year. It was not until he put an ad in *QST* that he received five inquires from hams who owned the rig. The price ranged from $450 to $700 for the basic rig plus a few options. So you can see that the selling price of this particular rig is close to its original asking price. The same appears to be true for the popular ICOM 551 models.

If one is looking for a recent Six Meter rig in the used market, it is a good idea to decide on the model(s) that would fit your needs. Ask yourself if you want a single band model or one that includes other bands. You may find that most local ham radio flea markets will not have what you are looking for, but larger type markets might. A classified ad can work well, as it did for my friend, but keep in mind the price range you are willing to work with.

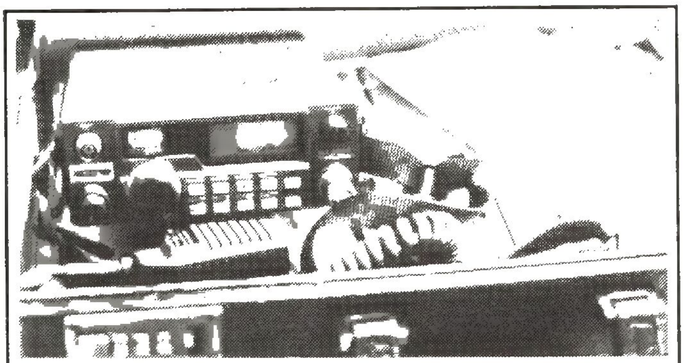
Manufacturers still continue to make specialty band rig packages that include Six Meters. An example of this is the ICOM-575A/H which has both Six and Ten Meters and the FT-650 which has Six, Ten and Twelve Meters. The ICOM-575A and the FT-650 have built in AC power supplies. These rigs are over $1,500 in list price, and would probably be recommended more for the serious Six Meter operator than for someone just starting out. They tend to be more like collector items and will generally will hold their value well.

Currently, there are only two single-band transceivers on the market today for Six Meters. One is the FT-690 Mark II. The newer technology that is employed is a far cry from the days of Clegg and

Gonset. This is one of the single-band, all-mode rigs that Yaesu makes along with a version for Two Meters and 440 MHz. The FT-690 features an interchangeable rear assembly that allows you to use either a battery pack that puts out 2.5 Watts or a linear amplifier that enables the rig to put out 10 Watts. The design pays attention to RFI problems with the incorporation of filter circuitry. I have found the rechargeable 2.5 Watt battery pack to be ideal for when I just monitor the band or when I do only local work. I've found that there are less wires to fuss with in this version and I can still hook it up to a linear amplifier and put out a respectable 60 Watts of power when needed. The rig is ideal for traveling. It fits nicely in an attache case and it allows one to make local Six Meter contacts in the areas that are visited. It is truly an ideal rig for mobile and portable work. I choose to use the supplied whip antenna for monitoring or local work only, even though I have been able to make a couple of long-range Sporadic-E contacts using it. I have measured at least a loss of two "S" units when comparing this whip with a regular quarter-wave vertical. The built-in loading coil only shortens the length by two feet, so why not use a full quarter-wave vertical for better signal reception and transmission?

The other single-band Six Meter transceiver on the market is the Kenwood TS-60. This rig is very similar to the TS-50 HF transceiver which is designed for portable and mobile work. The TS-60 puts out 90 Watts at full power and has a list price in the $1000 range. Six Meters is very popular in Japan and this affects the market elsewhere where the selection may be limited to outside markets.

There are a few handie-talkies that feature Six Meters. Azden makes a five Watt model designated as the AZ-61 for Six Meter FM. This radio has extended receiver coverage for the entire band and has a one-half Watt position that is ideal for local work. Tokyo Hy-Power makes an SSB and CW HT designated the HT-750 which features 40, 15 and 6 Meters at less than three Watts output. This draws more power than the FT-690 II, both in the receive and transmit modes. The transmit mode draws 1.5 Amperes on the HT-750 as opposed to 1.1 Amps for the FT-690 II for the same two Watts output. This may present some limitations for portable work in terms of length of time you can operate before requiring recharging. As mentioned before with the FT-690, there is also a loss of efficiency when using the supplied whip antenna with these types of rigs. These antennas are shortened from a quarter-wave by the use of a loading coil. These make great monitoring radios when you are away from your home station and would be suitable for local work and for on the road.



The FT-690 Mark II. This is the only all-mode Six Meter transceiver on the market at the present time. Options include a battery pack configuration which has 2.5 Watts output or a version with a 10 Watt linear amplifier. The small size of this rig makes it easy to carry over the shoulder or in an attache case. —photo by Ken Neubeck, WB2AMU.

An option that can also be considered for those who own HF equipment is to build or buy a transverter or converter to go on Six. Typically, these transverters work off the 10 Meter band of the HF rig in order to work on Six. Commercially–made transverters and converters were very popular 20 years ago and are somewhat scarce in today's used equipment market. Popular models include the Yaesu FTV-107R and the FTV-650B which were made some time ago and are somewhat scarce on the used equipment market. Newer models are currently made by Tokyo Hy-Power. Homebrewing a transverter is an option and there are designs presented in previous *ARRL Handbook* editions. There aren't many Six Meter operators who use transverters, let alone a homebrew one. It is much easier to get hold of a Six Meter rig.

There are some drawbacks to transverter use. First, they add another box to the system that also requires 13.8 Volts to power it. If you are already using an external amplifier, you can end up with a cluttered desk with all of these boxes plus the required power supplies. Secondly, the question has to be asked, how much are you really saving? Transverters are only a couple of hundred dollars cheaper than buying a fully equipped Six Meter transceiver. Finally, you may not be able to convert all modes as opposed to having them already in a dedicated Six Meter rig.

Along the line of conversion, a number of commercially made walkie-talkies that operate on 49 MHz can be converted for Six Meter use. You can

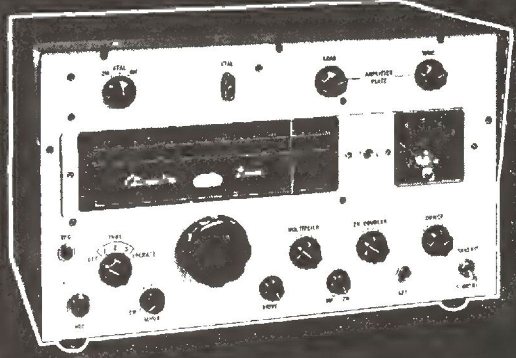
The Mirage A1015G linear amplifier. This amplifier is capable of taking a 10 Watt signal and amplifying it to 150 Watts output. In addition, it has a built-in pre-amp which helps signal reception. The heat sink on top of the unit leads to the nickname "brick" and the unit can easily be used for both mobile and base applications. — photo by Ken Neubeck, WB2AMU.

find these radios at Radio Shack and similar stores for a fairly low price. These radios are FM transceivers that are commonly used for home use and run less than one Watt of power output. Conversion to Six is not too difficult and the costs are low, however you can only go into the FM mode. If you do not have an FM repeater or a local group of hams that frequent the FM portion of Six, the payback for such a conversion is minimal. Likewise, the same would be true for modification of commercial AM rigs because the amount of AM activity on Six tends to be confined to sporadic areas of the country. Conversion of a commercial SSB rig would be more viable, however there are not too many of these types around.

Newer commercially-made Six Meter amplifiers that exist currently, combine the functions of a linear amplifier for the transmitter and a pre-amp to aid the receiver. One commercial model that currently exists is the Mirage A-1015-G. This particular model can take a 10-Watt input signal and amplify it to 150 Watts output. In addition, the pre-amp amplifies signals so they are received better than with the conventional receiver alone. Both features are ideal when conditions are borderline, such as a weak Sporadic-E opening. However it may not be a good idea to have the amplifier on all of the time if you are not too sure if your station will suddenly be on the neighbor's TV. These commercially made amplifiers typically have the same design, where the top of the unit is a large heat sink for dissipating heat. There are a number of vintage linear amplifiers that may still be found at flea markets. One model is the Gonset 913A which puts 500 Watts into the finals.

While it is not imperative to use special equipment to enjoy Six, it can make a difference when conditions are not optimal. Certainly, one can just use a rig to an antenna and do well with just that. It's just that the additional equipment makes life a little bit easier and more enjoyable. The same can be said for antennas which will be discussed in detail in the next chapter. Excellent success can be obtained on Six even if you use a simple dipole or vertical antenna. However, directional antennas such as a three-element Yagi can help pull out more signals and make life better for the Six Meter operator.

A portfolio of vintage Six Meter radios



New Climaster

ZEUS

TRANSMITTER

2 Meters & 6 Meters

175 WATTS

AM—CW

50 MC-54 MC 144 MC-148 MC

. . . with Automatic Modulation Control and Clipper-Filter Circuitry capable of producing more usable "talk power" than many kilowatt rigs.

(3.5 MC-30 MC and 220 MC adapters available soon)

GUARANTEED

to produce more carrier output and higher modulation power than any other presently available commercially-built amateur VHF Transmitter

Note some of the many features found only in this outstanding new VHF Transmitter:

- High Level Plate and Screen Modulation
- Highly Efficient Type 7034 Final Amplifier
- Self-Contained Stable VFO
- Built-In Automatic Modulation Control
- Simple Band Switching and Tune-Up
- Two Unit Construction with Remote Modulator and Power Supply Conserves Space at Operating Position
- Attractive Styling

Amateur Net Price: **Only $559.** Completely wired and tested with all tubes, Modulator, Power Supply, VFO, cables, etc.

Coming Soon-Matching VHF RECEIVER!

Clegg LABORATORIES

RT. 53, MT. TABOR, N. J. • OAkwood 7-6800

One of the many Six Meter rigs that was offered by Clegg in the early 1960s. This company was dedicated totally to VHF equipment and was considered the Collins of its class.

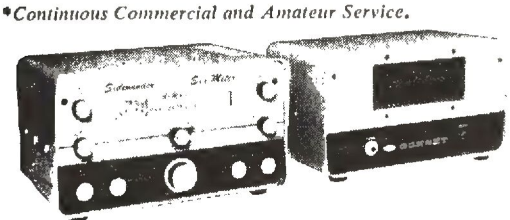
POWERFUL BIG NEWS

NEW!...2 METER–6 METER RF POWER AMPLIFIERS

More power in the VHF band!... and there is *plenty* of it in the new Gonset 2 and 6 Meter RF Power Amplifiers. Model 903A (2 meter) and Model 913A (6 meter) has a power input of 500 watt in all modes of operation. A 4X150A is used in the final, and the equipment is rated for CCAS* service. Only 5 watts is required to drive the 903A and 913A to full rated output. Output impedance is 50 ohms nominal with an input impedance of 50 to 75 ohms. The all solid state power supply is self-contained within the amplifier chassis. All stages are metered and all controls are on the front panel for ease of operation. The new linear amplifiers may be used with any of the famous Gonset Communicator series, as well as being ideally compatible for the new Gonset Sidewinder series.

Amateur Net Price $299.00

**Continuous Commercial and Amateur Service.*



NEW!...GONSET SIDEWINDER 6 METER SSB-AM-CW TRANSCEIVER

The new Gonset Model 910A *Sidewinder* offers coverage of the entire 6 meter band in 1 mc segments. Like its mate—the Model 900A 2 meter *Sidewinder*—this ultra-compact transceiver features all-transistor receiver and power supply and partially transistorized transmitter (except mixer, driver, and final stages). Designed for mobile or fixed communications, the unit operates with separate AC (shown above) or DC power supplies.

...COMES IN POWERFUL LITTLE PACKAGES from GONSET

SIDEWINDER SPECIFICATIONS:

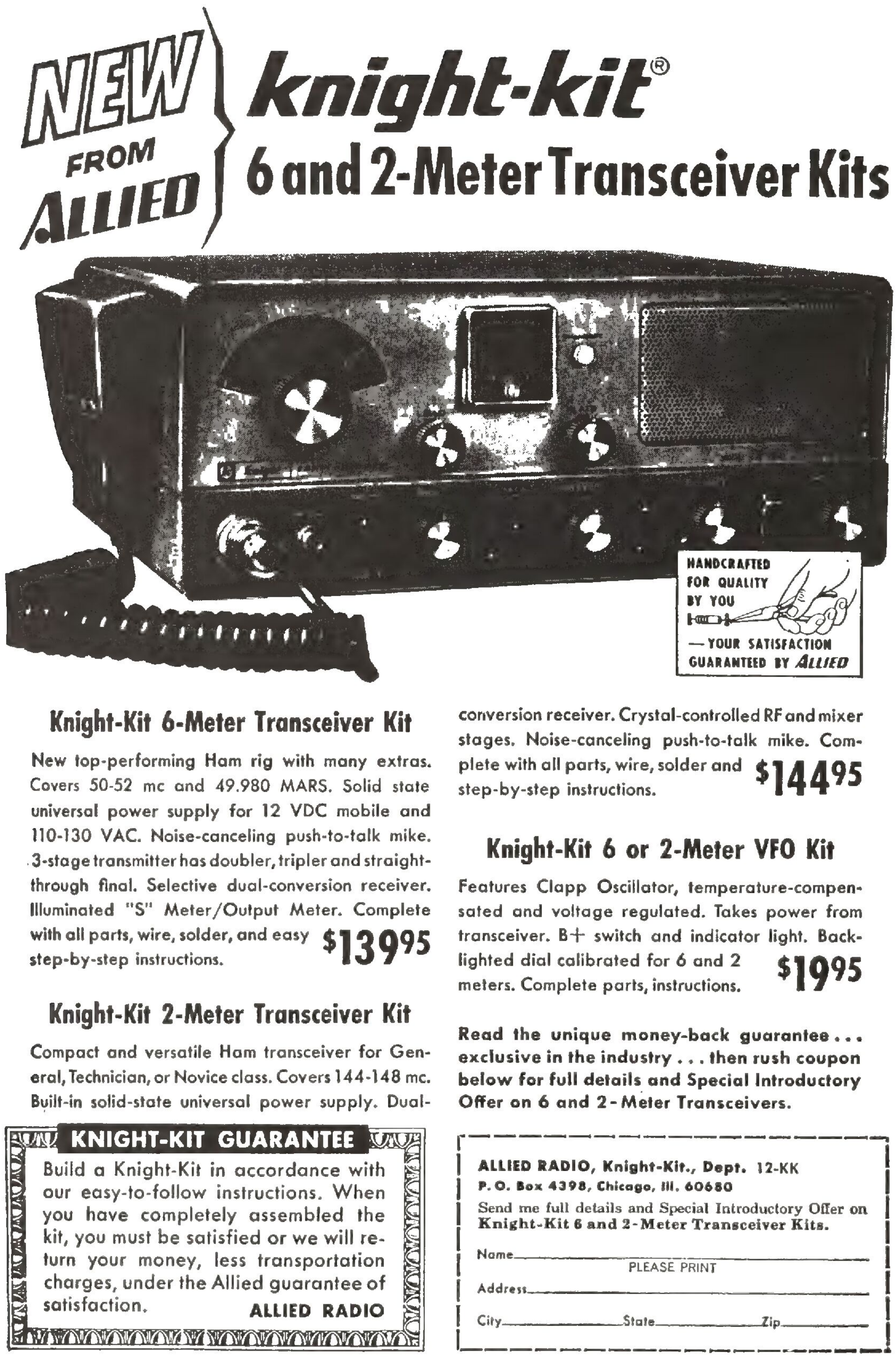
TRANSMITTER:	
Power Input:	20 watts PEP (SSB) 6 watts AM 20 Watts CW
Spurious Suppression:	–40 db
Carrier Suppression:	–50 db on SSB
Unwanted Sideband Suppression: VFO or Crystal Control	–40 db
RECEIVER:	
Frequency Stability:	Highly stable incremental tuning utilizes same VFO as transmitter
Sensitivity:	½ μv or better for 10 db $\frac{S+N}{N}$
Selectivity:	Lattice crystal filter for both receiver and transmitter
Spurious Rejection:	–50 db or better
Image Rejection:	–50 db (both receiver and transmitter utilize double conversion)
AMATEUR NET:	$399.50
AC Power Supply	$ 67.75
DC Power Supply	$ 79.50

ANOTHER NEWSWORTHY NOTE: *the Gonset GSB-201 Linear Amplifier was recently increased from 1500 to 2000 watts PEP (SSB). For those who operate on 10 to 80 meters—the GSB-201 is a natural companion for any of today's exciters.*

WOULD YOU LIKE TO BE PLACED ON OUR NEW PRODUCT MAILING LIST?
We'll send you complete information on the products above and keep you informed of new Gonset developments from time to time. Merely write Dept. CQ-4

GONSET, INC.
ALTEC LANSING CORPORATION
LTV *A Subsidiary of Ling-Temco-Vought, Inc.*
1515 SOUTH MANCHESTER AVENUE, ANAHEIM, CALIF.
© 1964 ALC

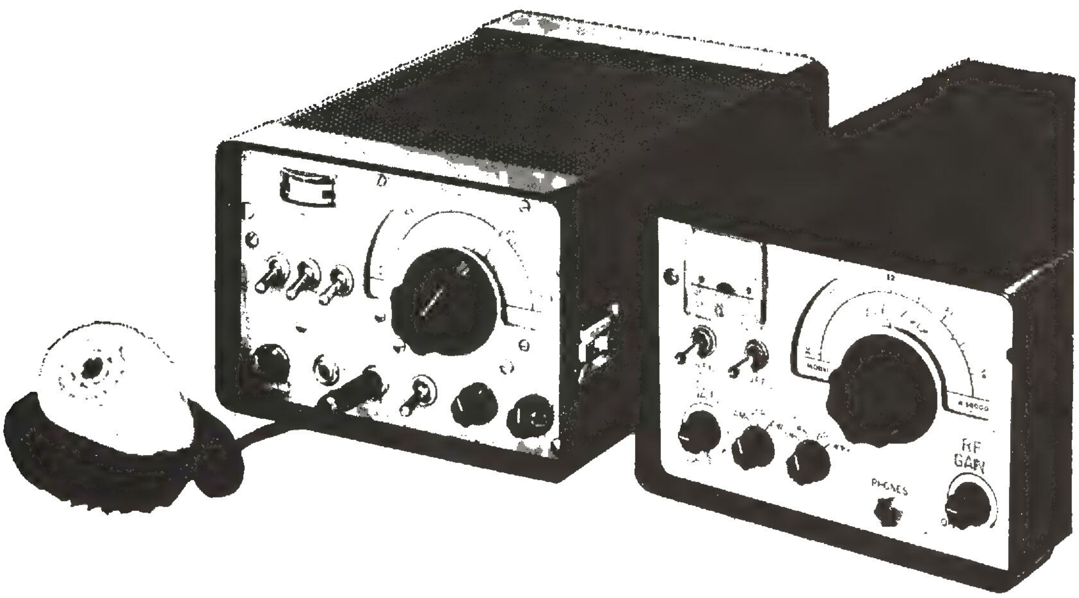
Gonset had a number of different model rigs for Six Meters during the mid-1960s. Notice how detailed specifications are provided in this ad.



Heathkit was not the only company to have a Six Meter kit on the market. Allied Radio had this Knight-Kit transceiver kit available in 1966.

DESIGNED FOR THE AMATEUR WHO IS

ACTIVE ON SIX



COMPLETE, SELF-CONTAINED STATION FOR FIXED, PORTABLE, OR MOBILE OPERATION.

LI'L LULU TRANSMITTER FOR 6

Special gang-tuned circuits in Li'l Lulu let you QSY instantly — there's no buffer tuning and final dipping needed when the frequency is changed. And the rig is really TVI proof! By keeping the VFO grid circuit in the 25mc range, TVI is eliminated.

• 117 vac, 12 vdc integral power supply. Class A high level modulation. Carbon dynamic or crystal mic input. Push-to-talk, or use panel switch • Built-in cw keying filter • VFO spotting switch • VFO control • 12 DQ7 final.

LI'L LULU RECEIVER FOR 6

Specially developed to complement the famous Li'l Lulu one-knob-controlled transmitter for 6 meters, the new Li'l Lulu receiver is unmatched for performance.
• AM, CW, SSB • Product detector for SSB • BFO crystal controlled • Delayed AGC operates on AM, CW, SSB • Integral front-end filter • Tunes 50-54 mc, and 10 mc for WWV and converter input • Critical components are temperature compensated • 10 mc crystal filter ahead of 3 IF amplifiers • Built-in CW monitor • ANL operates in all modes • S meter controlled by non-delayed AVC • Front panel control for companion transmitter — 80 to 1 drive reduction for precise tuning • Matches the Li'l Lulu transmitter.

WHIPPANY LABORATORIES, INC.
A subsidiary of Industron, Inc.
77 Jefferson Avenue, Westwood, New Jersey

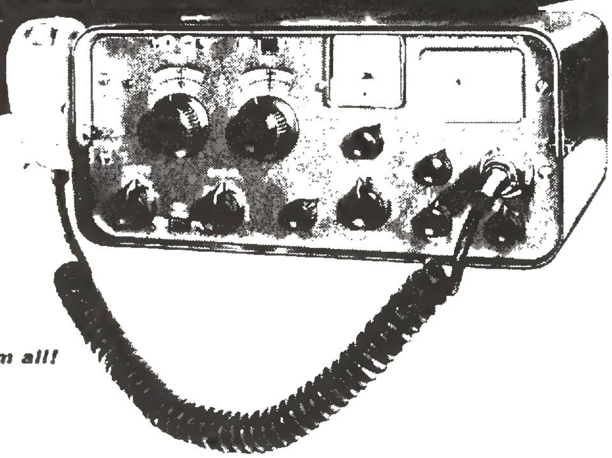
It seemed that just about everybody was in the Six Meter equipment market during the 1960s. Here is an offer from a little-known company that is no longer with us.

From Polytronics:

THE POWERFUL POLY-COMM "62" B, VHF TRANSCEIVER

For Novice, Technician and General

COVERS BOTH THE 6 AND 2 METER BANDS



Rugged... dependable... feature by feature the Poly-Comm "62" B outclasses them all! O.C.D.M. Approved.

The unbeatable Poly-Comm "62" B covers 250 kc either side of both bands for C.A.P. use . . . it has 18 watt power input . . . S meter doubles as tune-up meter, actually samples R.F. for maximum output . . . 100% plate modulation . . . V.F.O. or crystal control for transmit . . . built-in 115 VAC/12 VDC power supply . . . triple conversion on two, dual on six . . . (crystal controlled) . . . delayed AGC . . . all oscillators voltage regulated . . . squelch and automatic noise limiter . . . sensitivity: better than .8 microvolts on two, better than .2 on six for 10 db S/N/N ratio . . . selectivity: (6 kc @ 6 db pt.) and stability assured by all temperature compensated circuits and Hi-Q IF stages utilizing 12 tuned circuits . . . single knob bandswitching . . . sparkling modulation for solid contacts . . . complete with under-the-dash bracket and ceramic microphone.

$349.50 amateur net COMPLETE

O.C.D.M. Model "62" CD...$349.50 COMPLETE

Antennas: PCA-251: (illustrated) Whip only. 2 & 6 meter dual band antenna. Standing wave ratio 1.1 to 1 at resonance and no greater than 1.5 to 1 at any point in the band. **$13.95**

PCA-249: Same as above with cowl mounting. Complete with 15 ft. RG-58/u cable and PL/259 connectors at both ends. **$21.95**

PCA-250: Same as above with standard stud, ball mount, cable and connectors. **$23.95**

At your electronics parts distributor or write for complete specifications to:

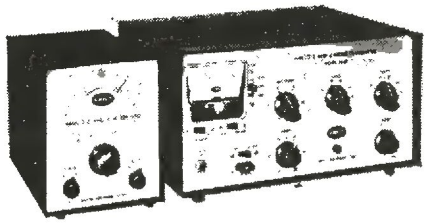
Clifton, N. J. · Phone: 772-1334

POLYTRONICS LAB inc.

This Polytronics offer may have been the first dual-band transceiver for VHF ever made. It came out in the early 1960s.

AMECO *Leader in Compact, Quality Ham Gear*

NEW VFO FOR TX-62 or any other VHF TRANSMITTER



NEW AMECO VFO FOR 6, 2 & 1¼ METERS

The new Ameco VFO-621 is a companion unit designed to operate with the Ameco TX-62. It can also be used with any other commercial 6, 2, or 1¼ meter transmitter.

Because it uses the heterodyne principle and transistorized oscillator circuits, it is extremely stable. An amplifier stage provides high output at 24-26 MC. The VFO includes a built-in solid state Zener diode regulated AC power supply.

This new VFO is truly an exceptional performer at a very low price **Model VFO-621 $59.95 net.**

The NEW AMECO TX-62

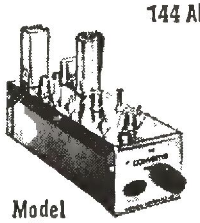
In response to the demand for an inexpensive compact VHF transmitter, Ameco has brought out its new 2 and 6 meter transmitter. It is easy to tune because all circuits up to the final are broadbanded. There is no other transmitter like it on the market!

SPECIFICATIONS AND FEATURES

Power input to final: 75W. CW, 75W. peak on phone.
Tube lineup: 6GK6—osc., tripler, 6GK6 doubler, 7868 tripler (on 2 meters) 7984-Final. 12AX7 and 6GK6 modulator.
Crystal-controlled or external VFO. Crystals used are inexpensive 8 Mc type.
Meter reads final cathode current, final grid current and RF output.
Solid state power supply.
Mike/key jack and crystal socket on front panel. Push-to-talk mike jack.
Potentiometer type drive control. Audio gain control.
Additional connections in rear for key and relay.
Model TX-62 Wired and Tested only $149.95

AMECO EQUIPMENT CORP. 178 HERRICKS RD., MINEOLA, L. I., N. Y.

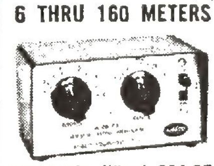
NUVISTOR CONVERTERS FOR 50, 144 AND 220 MC. HIGH GAIN, LOW NOISE



Model CN

Has 3 Nuvistors (2 RF stages & mixer) and 6J6 osc. Available in any IF output and do NOT become obsolete as their IF is easily changed to match any receiver. Average gain — 45 db. Noise figure — 2.5 db. at 50 Mc., 3.0 db. at 144 Mc., 4.0 db. at 220 Mc. Power required 100-150V. at 30 ma., 6.3V. at .84A. See PS-1 Power Supply. Model CN-50W, CN-144W or CN-220W wired. (specify IF.) **$49.95.** Model CN-50K, CN-144K or CN-220K in kit form. (specify IF.) **$34.95**

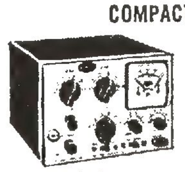
ALL BAND NUVISTOR PREAMP 6 THRU 160 METERS



MODEL PCL, Wired, $24.95
MODEL PCLP, with built-in power-supply, wired, $32.95

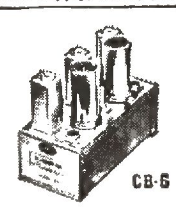
2 Nuvistors in cascode give noise figures of 1.5 to 3.4 db. depending on band. Weak signal performance, image and spurious rejection on all receivers are greatly improved. PCL's overall gain in excess of 20 db. Panel contains bandswitch, tuning capacitor and 3 position switch which puts unit into "OFF," "Standby" or "ON," and transfers antenna directly to receiver or through Preamp. Power required—120 V. at 7 ma. and 6.3 V. at .27 A. —can be taken from receiver or Ameco PS-1 supply. Size: 3"x5"x3".

COMPACT 6 THRU 80 METER TRANSMITTER



Model TX-86

Handles 90 watts phone and CW on 6 thru 80 meters. Final 6146 operates straight thru on all bands. Size — only 5" x 7" 7 7" — ideal mobile or fixed. Can take crystal or VFO. **Model TX-86 Kit $89.95 — Wired Model TX-86W, $119.95. Model PS-3 Wired $44.95. Model W612A Mobile Supply wired $54.95.**



CB-6

CB-6K — 6 meter kit, 6ES8-rf Amp., 6U8-mix./osc. $19.95
CB 6W — wired & tested $27.50
CB-2K — 2 meter kit, 6ES8 1st rf amp., 6U8 — 2nd rf amp/mix, 6J6 osc. $23.95
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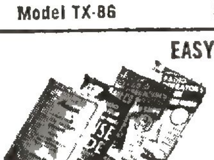

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Amateur License Guide .... .50
Radio Operators' Lic. Guide, EL 1-2 .... .75
EL 3 .... 1.75 EL 4 .... 1.25
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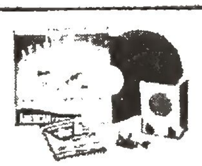

Ameco has the most complete line of code records, code practice oscillators and Keys. Code courses range from start to 18 W.P.M. and are on 33, 45, or 78 r.p.m. records. Model CPS oscillator has a 4" speaker and can be converted to a CW monitor.

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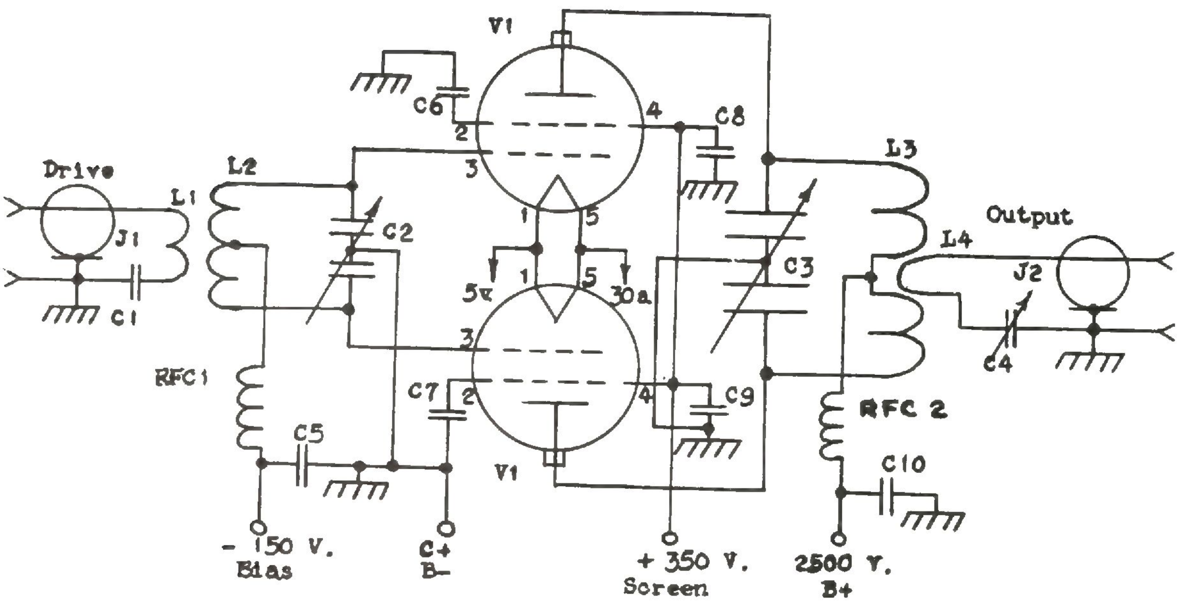
AMECO made a number of Six Meter accessories and starter kits to accompany their well-known theory course books and records.



Parts List

C1 25 uuf ceramic or mica
C2 30 uuf dual section (Hammarlund HFD-30x)
C3 20 uuf dual section (See Text)
C4 35 uuf variable (National ST-35)
C5-C9 .001 600V. disc ceramic
C10 .005 20,000 V.TV doorknob
J1-J2 UHF coax connectors
RFC1-RFC2 Z-50

V1,V2 Eimac 4-250
L1 2Turns #16 insulated 1" dia.
L2 6 Turns #16 bare wire 1" dia.,1¼" long with 3/8" space in center for L1.
L3 3½ Turns 3/8" copper tubing 3"dia 2⅛" long with a 7/8" space in the center for L4
L4 1 Turn link #8 copper wire 3" dia.

Here is a schematic of a Six Meter amplifier that appeared in the January 1961 issue of ***The VHF Amateur****, a monthly magazine that was devoted to VHF.*

50-Mc. Transmitter

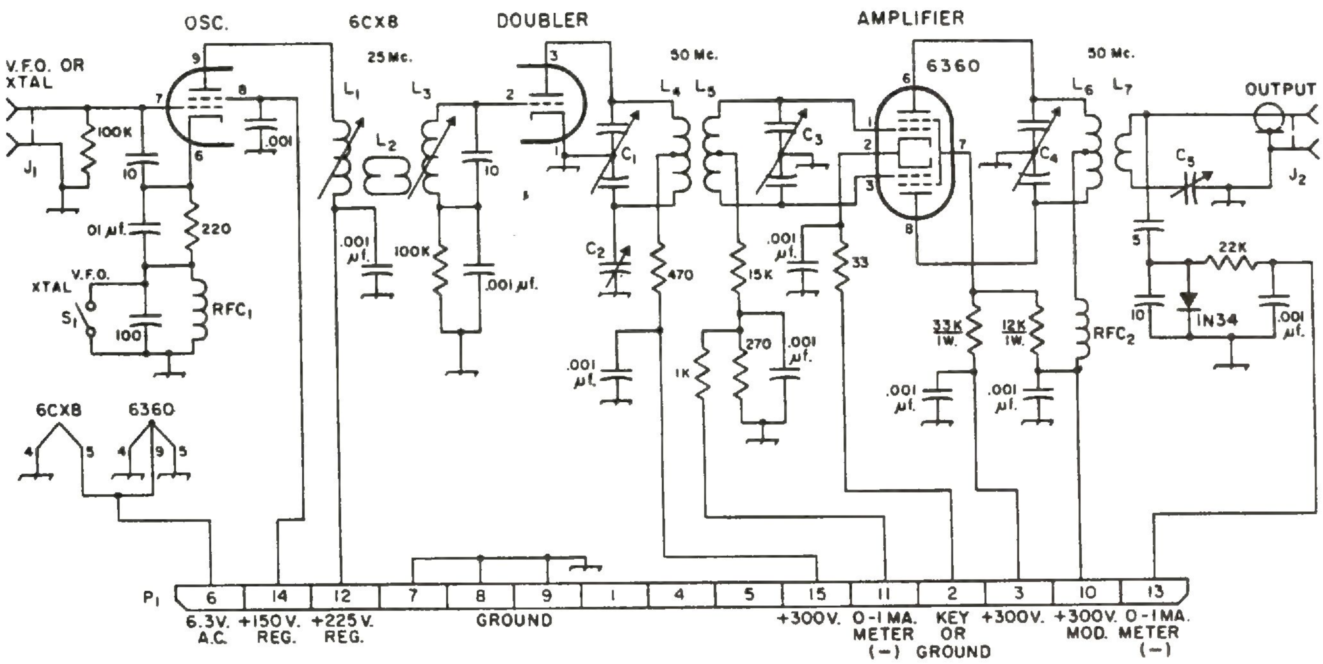


Fig. 17-4—Circuit diagram of the 50-Mc. transmitter. Unless specified otherwise, capacitances are in picofarads (pf. or µµf.), resistances, are in ohms, resistors are ½ watt. Fixed capacitors are ceramic.

C_1—8-pf. miniature butterfly variable (Johnson 160-208).
C_2—3-30-pf. mica compression trimmer.
C_3—5-pf. miniature butterfly variable (Johnson 160-205).
C_4—11-pf. miniature butterfly variable (Johnson 160-211).
C_5—50-pf. miniature variable (Hammarlund MAPC-50).
J_1—Crystal socket.
J_2—Coaxial receptacle, SO-239.
L_1—3.1–6.8-µh. variable inductor (Miller 4405).
L_2—¾-turn link of insulated hook-up wire around cold ends of L_1 and L_3. See Fig. 17-4.
L_3—1.5–3.2-µh. variable inductor (Miller 4404).
L_4—10 t. No. 20, ¾-inch diam., 16 t.p.i., center-tapped (B & W 3011).
L_5—8 turns, same material as L_4.
L_6—9 turns, same material as L_4.
L_7—2 turns insulated wire around center of L_6.
P_1—15-contact plug with brackets (Cinch-Jones P-315-AB).
RFC_1—750-µh. r.f. choke.
RFC_2—7-µh. r.f. choke (Ohmite Z-50).
S_1—S.p.s.t., toggle.

Here is a schematic of a Six Meter transmitter design that appeared in the 1965 ***ARRL Radio Amateur's Handbook.***

Chapter 5
Antennas

There are more different antenna designs for Six than any other Amateur Radio band. Not only do you have conventional antennas such as verticals, dipoles and beams but there are a number of unique design that were commercially made such as discones, Squalos and Halo antennas. Many of these unique designs came as a result of specific needs of the individual ham as whether he needed a mobile antenna that was omni-directional or a home antenna with a lot of gain.

Six can also be called the homebrew antenna band. Because of its relatively small wavelength, it is a great band for amateurs to build many different types of antennas. A dipole on this band is less than ten feet in length (112 inches for the low end of the band) and a quarter-wave vertical is 56 inches high. The basic antennas are very easy to construct and put up. You can see how extended designs such as Yagis and Quads can be homebrewed for this band. Very often good HF antennas come out of work that is done on the Six Meter band. In many cases, a homebrewer can build a decent antenna that is as good as if not better than the commercial antennas, and for a lot less money too! We also will discuss some of the vintage commercial antennas that can still be found in flea markets such as the Saturn 6 and the Squalo which were developed primarily for mobile work.

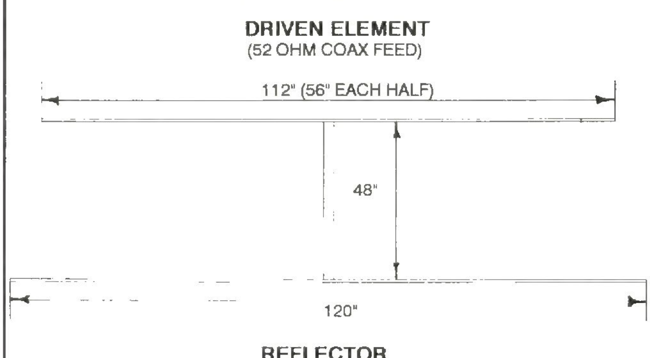
The first thing for the Six Meter operator to decide is what polarization he wishes his antenna to be, vertical or horizontal. If most of the local hams in the area have horizontally-polarized antennas, you should have the same polarization so that signal strengths will be decent. Mobile work generally dictates the use of vertical type antennas. If you work mostly long-haul DX stuff, polarization really does not matter. A vertical beam will work the same way as a horizontal beam for this type of work. I have worked a good number of DX stations using a vertical with modest power on both Es and F2 openings.

Once the polarization issue is settled for your type of operation, the next question becomes what type of antenna to use and how high to put it. A dipole or inverted-V are decent antennas to put up on Six if there are space constraints. It takes minimal effort to put up a piece of wire above the top of the house and it is not too conspicuous to the neighbors who may be looking for a scapegoat to blame their RFI problems on. I have found that this is a suitable setup for my QTH which is in a fairly dense suburban community. The dipole draws little attention and subsequently no complaints. Likewise the same arguments could apply for a vertical antenna that is situated on the roof.

One of the goals for the station is to achieve maximum gain in the antenna setup. There is a saying which goes, "Try to achieve gain in the metal rather than in the rig." Gain in the "metal" (the antenna) is more desirable for some very good reasons. By having most of your gain in the antenna, you can run lower power and generally run a reduced risk of RFI problems. Also, more effective increases in gain are achieved in the antenna rather than simply adding a linear amplifier to the station.

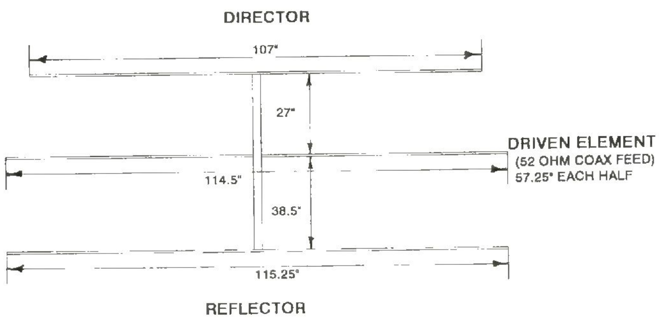
For those who can put up a directional antenna on a tower such as a Yagi, a number of technical issues have to be addressed. A strong mast that can support a rotator is required. Optimal tower height is desired in order to reduce interference concern. Perhaps the biggest concern is how many elements should your beam have. The element count will determine how sharp your pattern is and whether you will be able to hear signals on the side of the beam. The type of beam will be in a large part be determined by the type of operating that you do on Six. Two- and three-element beams are good for normal usage or for average contest operating. For modes such as meteor

Figure 5-1
Two element Yagi for Six Meters
(driven element and reflector)
Dimensions for SSB portion @ 50.1 MHz



Design by WB2AMU

Figure 5-2
Three element Yagi for Six Meters
(driven element, reflector and director)
Dimensions for SSB portion @ 50.1 MHz



Design by WA4AUX

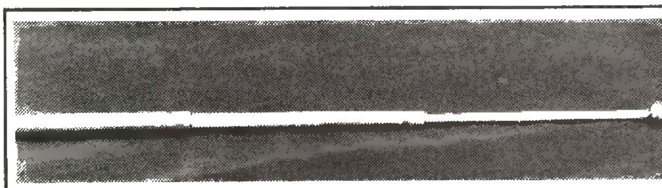
shower work or advance contesting, more elements may be required.

A two-element Yagi is very easy to construct and the payback in signal output strength and signal reception is worth the effort. Figure 5-1 (pg. 36) shows a simple design that I use which yields satisfactory results. The physical dimensions follow the basic formulas for this type of beam with the driven element a half-wavelength and the reflector 110 percent of a half-wavelength. The .2 wavelength spacing is standard rule-of-thumb which allows for a 50-Ohm feed to be used. With this design, there is a modest front-to-back ratio that results in an actual difference of two or three "S" units. The beam has a gain of about 4 dB over a dipole and while it has a good front-to-side ratio, you will still be able to hear signals on the side of the beam so that you can move your beam to zero-in on them. I have used an interesting variation of this design. I use in place of the standard aluminum tubing, telescoping car radio antennas for each of the legs of the beam. This allows me to use the antenna for portable work such as hilltopping. I can collapse the elements and fit the beam inside my car. Many of these replacement antennas will fall in the range of a quarter-wavelength on Six, making them ideal elements for a Yagi antenna or a magnet-mounted vertical.

Some hams may find that two elements may not suit them, so they go to three elements. Figure 5-2 shows a design given to me by Joe Crawford, WA4AUX, who has achieved excellent results with this arrangement. There is an increase in front-to-back ratio over the two-element Yagi and also a modest increase in gain. You will note the tighter spacing between elements in comparison to the two-element Yagi. This is a standard antenna configuration that is used by a lot of hams on Six and it will yield satisfactory results. You will be able to hear some stations on the side of the beam so that you will be able to swing your beam towards their direction. Likewise, you will still be able to work stations off the back of your beam too.

You will find many hams using more than three elements. Five– to ten-element Yagis are frequently found on Six. They have tremendous front-to-back ratios and can allow an operator to use low power with no appreciable loss in his signal strength. However, drawbacks include a much longer boom-length that is required to hold all of the elements. A ten-element beam's boom can easily exceed 20 feet in length and this may be harder to keep up and rotate. In addition, the antenna's receiving pattern becomes very sharp. You will not be able to hear stations on the side of your beam so your rotator system will get more of a workout when you are searching for stations.

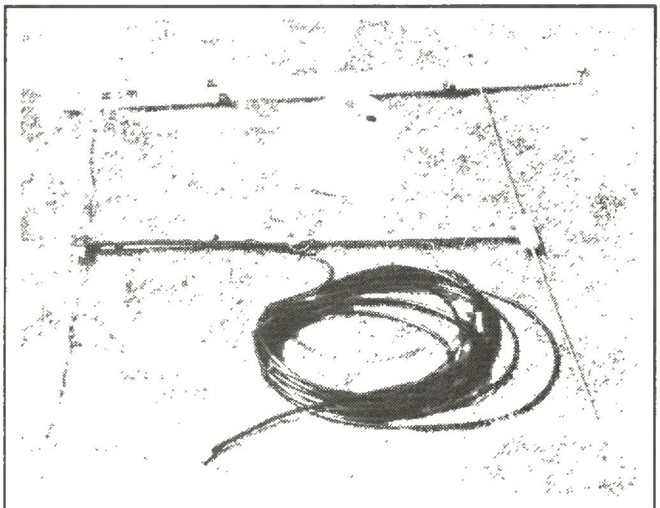
You do not need an excessive amount of height for Yagis or other antennas on Six at your home station. There is an optimal height that will achieve the desired low angle of radiation and for Six, this will fall in the 30- to 50-foot range in height. Any higher than that does not buy you that much more in angle of radiation or in signal reception. In fact the lower height seems to be more ideal for meteor scatter work as detailed by Larry Jones, WB5KYK, in Chapter 3. A fair amount of height is desired to help prevent RFI problems both at your house and in the neighborhood. Unfortunately, it is hard to explain to neighbors how a taller tower will actually be a better situation overall. They can't see that by having your antenna higher than their TV antennas or other reception devices in the house, that



A closeup view of the telescoping element that can be used for either a quarter wave vertical or as one of the elements of a Yagi beam. —photo by Ken Neubeck, WB2AMU.

there will be less interference. To them a tower may be an eyesore in the neighborhood. Unfortunately for the ham, even though the FCC rules favor them, there are many restrictive covenants or town ordinances. God forbid that there is an RFI problem in the neighborhood. The ham with the tall tower will be blamed. This is an automatic corollary of Murphy's Law. So plan carefully for your antenna setup.

There have been a significant amount of commercially-made antennas for Six, since the early days. Like transmitters, there have been a number of American companies that have gone by the wayside since the glory days of Six Meters. These include Finco and Hi-Par. However, the comparison with the manufacture of transceivers stops here, as there are a number of American companies that currently make antennas for Six. This includes Cushcraft, M^2 (who has a number of beam models) and Diamond which has vertical models. One thing about the used antenna market is that the antennas may not necessarily wear as well as used rigs. Sometimes you may luck out and find an antenna that was hardly used. The more unusual antennas for Six, which are no longer manufactured, such as the Saturn 6 is one that might fall in this category as you do not see them too often on cars. Thus one would suspect that any remaining Saturn 6 antennas may be stored away in a garage or basement somewhere.

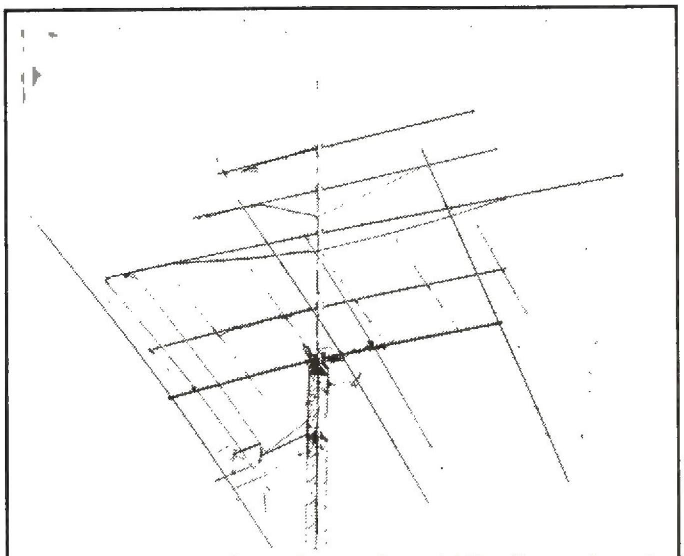


The two-element beam is shown here in the retracted position along with mast sections and feedline. This design is compact and lightweight in addition to being strong, and is easily transportable in the car. — photo by Ken Neubeck, WB2AMU.

The portable two-element Yagi is shown here deployed at the north shore of Long Island, overlooking the Sound 100 feet above sea level. The beam has telescoping elements that can be pulled in and easily placed in a compact car. — photo by Ken Neubeck, WB2AMU.

For mobile work, mag-mounted verticals are easy to use for Six but there are many other alternatives. These include variations of the Halo antenna which had variations that were commercially–made, such as the Saturn 6 and the Squalo. If you can find these antennas at a flea market or yard sale, buy them! They are collector items among the Six Meter community. They have the advantage of being omni-directional and horizontally polarized which are desired features in mobile work. Remember, a full-size Halo would have to be more than three feet in diameter, which is too big for most cars. What the Saturn 6 and similar antennas are is actually a compromise from a full-size Halo. It does this by making the diameter of the ring smaller through the use of a tuning bar at the feed points along with capacitance tuning at the open ends. The tuning is relatively sharp because of the high Q involved. It is not as forgiving as a regular horizontal or vertical antenna.

Figure 5-3 (pg. 41) shows the dimensions for a full-size Six Meter Squalo that could be used as a home station antenna, beacon use, or for larger cars. A full-size Squalo is basically a dipole that is bent into a rectangle with an open gap in one size. The dimensions shown are for use in the SSB portion of the band. Standard quarter-inch or half-inch tubing can be used along with plumbing hardware such as elbows for the corners. The capacitor plates at the open end should be at least a few inches in diameter. It is important to note that optimal SWR tuning can be achieved by moving the open end of the antenna where the capacitor plates are, in or out. A gamma match, which uses a tuning capacitor, is recommended and this would be installed at the feedpoint. The



This is the setup of Frank Moorhus, AA2D. Somewhere in this structure is a Six Meter Yagi. — photo by Frank Moorhus, AA2DR.

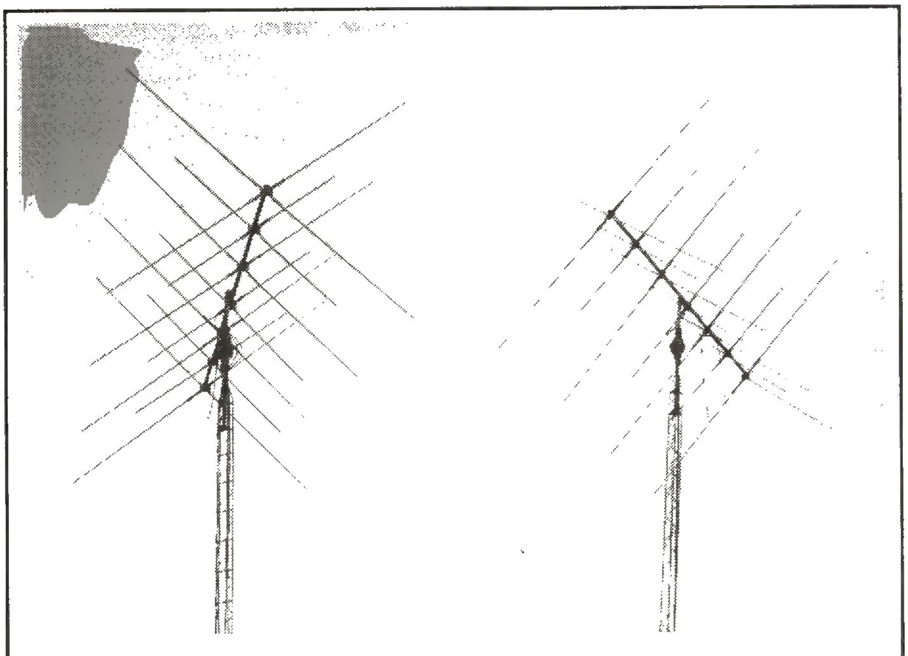
single-element Squalo will give a nice omni-directional pattern which is suitable for broad-pattern applications such as beacon work. If one wants more gain, additional elements of the same size can be added. This would involve some more tuning for minimum SWR. The pattern for the Squalo is essentially the same as the Halo antenna. The Halo can be built using the same dimensions as the Squalo, with the rectangle shape being reconfigured to a circular form, but this would require a little more effort to maintain this shape hence the Squalo is recommended.

The type of operating you do will, for the most part, determines what antenna is best for you. Long-range DX or contest work would be best served by a directional antenna such as a Yagi. A Squalo or Halo is a poor choice for contest work or Field Day exercises because of its broad pattern. However, the Squalo/Halo combination works well for mobile work. So consider what is the best choice for your style of operating.

An area of major concern for 50 MHz antennas is the feedline that is used. The type and quality of feedline that you use in your antenna system can sometimes be taken for granted. However, if you use the wrong type of coax to feed your antenna, you could lose a substantial amount of your power in the feedline. This is particularly important on Six for low power applications. You want to squeeze out all the power that you can. It makes no sense to put in all of that effort to get on Six, only to lose signal output in the feedline. A good practice that is followed by most Six Meter operators is to use the thickest 50-Ohm coax that they can find. Typically, RG-8/U is good stuff. Other types that are recommended for use on Six are RG-213/U and 9913 cables. Also use only the length that you need, do not have too much extra length of cable on the feedline.

There are some accessories for the 50 MHz operator to consider for an optimal setup. One is the use of an antenna rotator system for rotating a directional antenna. Certainly, this is a requirement for an operator who has a multi-element array as direct bearings are needed to optimize signal reception and transmission. There are heavy-duty rotators made that would be suggested for big arrays located very high on the tower. These rotators can be susceptible to adverse weather conditions, so it is recommended that they be placed in a spot on a tower than is accessible for repair if required.

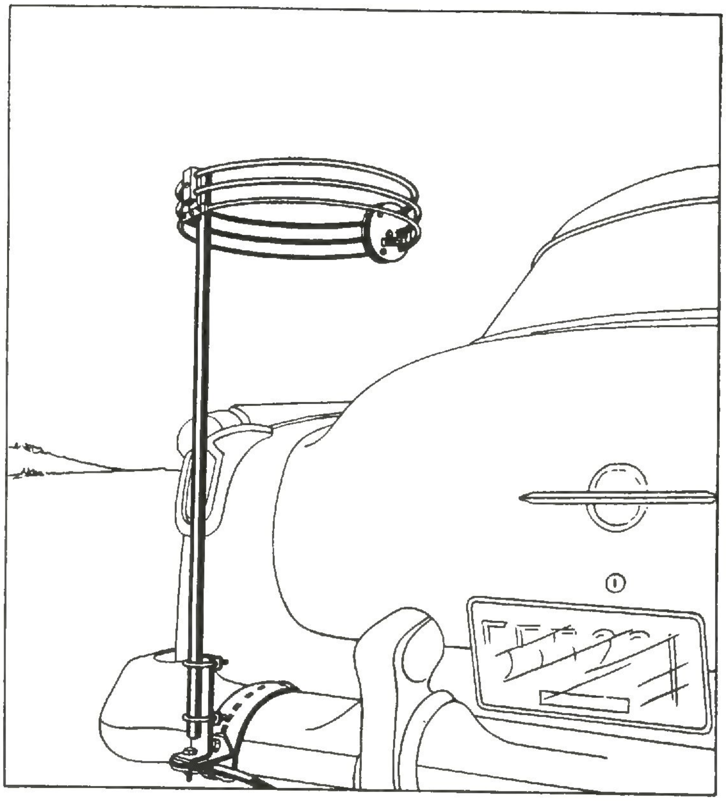
One may ask if an antenna tuner could be used on Six. The new rigs that have built-in tuners do not have Six Meter tuning capability even though Six Meters may be provided as part of the band coverage package. Practically speaking, antenna sizes for Six Meters really preclude this as a requirement. The possibility exists that one may want to tune down an HF long-



This is the antenna setup of Tom Glaze, KC4SUS, near Miami, FL. Tom has a seven-element Six Meter cubical quad nestled inside a four-element Ten Meter cubical quad. Tom typically runs 8 Watts output with the Six Meter quad as he gets high gain on the order of 14 dB. —photos by Tom Glaze, KC4SUS.

"SATURN 6" MOBILEER

Horizontally Polarized Antenna for 6 Meters



Since most amateurs operating in the six meter band have adopted horizontal polarization at their permanent QTH, usually with beams of one type or another, the cross polarization occuring when operating mobile to QTH has presented a serious problem.

The special design of the "Saturn 6" has eliminated this problem and minimized many others. In field testing, some amazing facts turned up. In hilly New England terrain, always tough for mobile to mobile contacts, unusual distances were worked solid. 50 to 60 mile contacts mobile to home QTH were not at all unusual. In comparison, under exact conditions, vertical whips provided an erratic weak signal and in many cases no signal at all. "Flutter" and "Swish" so prominent with vertical whips was practically eliminated. A surprising drop in ignition noise, especially from other cars was noticed. All around performance rose sharply with all makes of receivers and transmitters.

Basically the "Saturn 6" is an end-loaded folded dipole antenna of unusual design. The 3 ring design is approximately 20" in diameter and 5" high. Design center is 50.5 MC but a unique trimmer between the capacitor plates permits resonating the antenna between 50.0 and 53.0 MC. It is easily fed with RG58/U cable through a simple "Q" Section. Made entirely of aluminum, the net weight is under 2 lbs. yet no sacrifice has been made for strength and rigidity. It can easily be supported on pipe, tubing or stiff rod. Various accessories are available to adapt the "Saturn 6" to trailer hitches or mobile mounts that may already be on the car.

Model S-1—"Saturn 6" Antenna, two piece adjustable aluminum mast, mast bracket, universal bumper hitch. No holes to drill. Co-ax feed line not included. .... $16.95 net.

S-2—"Saturn 6" Antenna only. .... $11.95 net.

S-3—Mast Bracket. Can be adapted to most mobile mounts and trailer hitches. .... $1.00 net.

S-4—Bumper Hitch. Fully adjustable trailer hitch, (no ball) will fit most all cars. .... $3.00 net.

S-5—Telescoping Mast. 3 piece mast that can be used for regular mobile work and extended to approximately 12' when car is parked for picnics, beaches, hill tops, etc. .... $3.50 net

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PRODUCTS COMPANY
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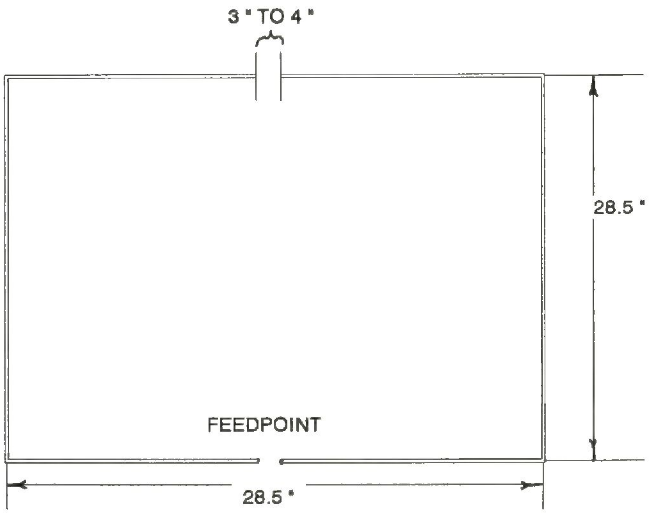
Here is the famous Saturn 6 antenna that was designed for mobile applications. The ad gives many of the critical dimensions, so if you are not able to find any of these vintage antennas at the flea markets, you can build a reasonable facsimile.

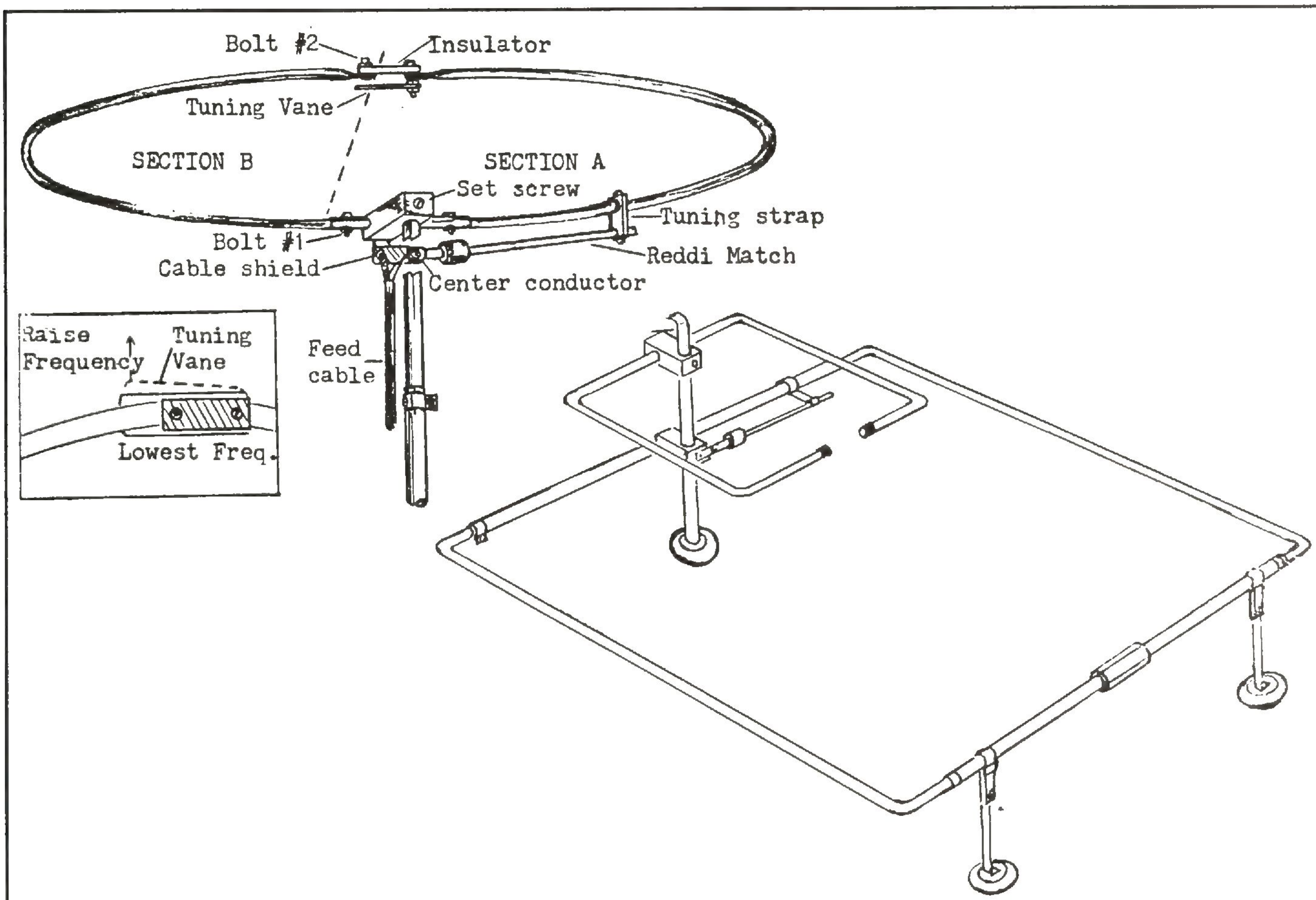
Figure 5-3
Single-element Squalo
Dimensions for SSB portion @ 50.1 MHz



Note: Adjust for optimal SWR of 1:1 by moving the tuning plate gap in or out.

wire for use on Six, but what is the pattern? A 30 Meter band dipole will probably be resonant on Six as it is an odd multiplier (five). But in general, it makes more sense to cut individual Six Meter antennas as there will be no question about the pattern. So an antenna tuner is not viewed as a requirement for Six Meters.

We have touched upon just a few of the antennas designs that can be used on Six Meters. For other possible designs, consult the various antenna books that exist such as the *ARRL Antenna Handbook*. Remember, just about any of the designs used on the HF bands are equally applicable on the Six. It's an ideal band on which to experiment with different antenna designs. It pays to have a stockpile of tubing and other materials available for building these different configurations.



Here are some examples of commercially-made Six Meter Halo and Squalo antennas in the 1960s. The figure at the top shows the standard single-element Halo with tuning bar. The bottom figure is a combined Two Meter and Six Meter Squalo for mounting on the roof of the car.

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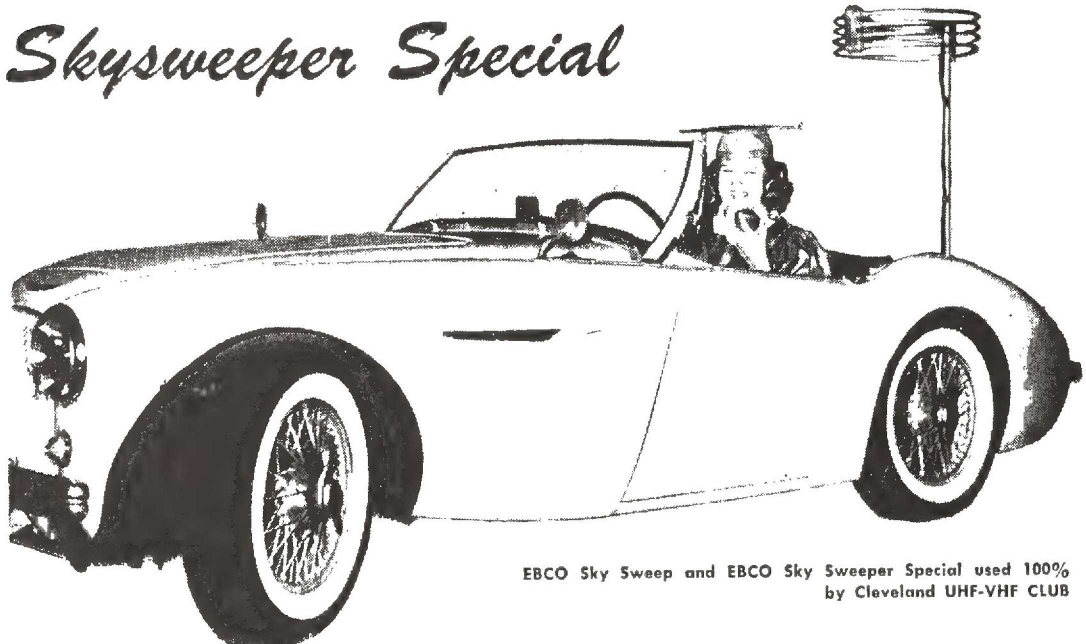

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Ebco was another company in the 1960s that specialized in the Six Meter Halo design and was in competition with Hi-Par, which made the Saturn 6. This is probably one of the corniest ham radio advertisements ever made.

Chapter 6
The Ultimate DX Band

Believe it not, Six *is* a DX band. Many hams may have been misinformed through the years and may have incorrectly thought of it as only a local communications band or just a vast expanse of empty space that no one uses. These hams would be pleasantly surprised at the significant amount of stations that are on this band as well as the tremendous amount of DX that is worked. Six has a tremendous worldwide presence and it does appeal to many hams.

There are different times throughout the year and throughout the 11-year sunspot cycle when great distances or rarely heard stations can be worked on Six Meters. During the peak of the sunspot cycle, F2 propagation on Six appears on a weekly basis. Long distance QSOs on SSB and CW of over 10,000 miles can be made. During the peak of the Sporadic-E season in the summertime, double-hop E-skip becomes so common that QSOs between stateside and Europe can occur. Incredible things can happen on this quiet band when you least expect it. The majority of DX work takes place in the SSB and CW portion of the band with some activity occasionally found in the AM phone portion and on the FM simplex frequency.

DX on Six can mean different things to different operators. The conventional DX operator may chase new countries just like other bands when conditions are good. Or the operator may choose to work other operators from areas marked off on the map as grid squares. This later system which was developed in Europe seems to be the most commonly used identifier on this band and has been in use worldwide for the past 10 years.

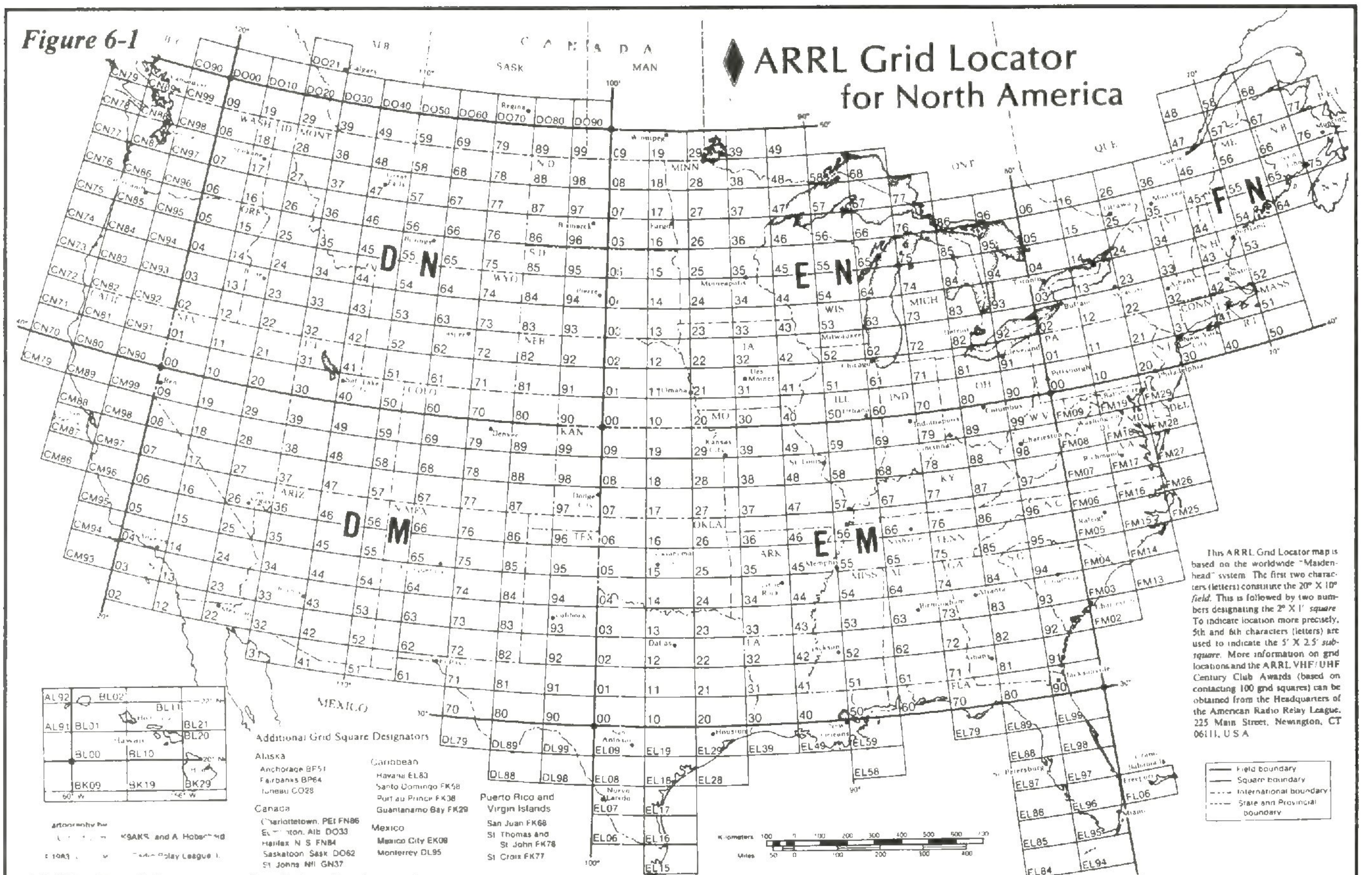
After a short time on Six, you will notice stations exchanging combinations of letters known as grid squares. A grid square is simply the subdivision of the earth into 2 degree wide by 1 degree high rectangles following the lines of latitude and longitude. There is a specific numbering system that is used worldwide much like there are specific prefixes for callsigns for the different DX countries. This grid method uses two letters followed by two numbers as the identifier. For example, my QTH on Long Island is located in grid FN30. See the ARRL Grid Square Map of North America in Figure 6-1 as an example. A simple program exists for the conversion of specific latitudes and longitudes into grid squares or one can easily do it manually.

The grid square system actually makes it easier for the Six Meter operator to be able to qualify for various awards. For example, it takes only a fair amount of effort with modest equipment to work 100 grid squares for a VHF/UHF Century Club award (VUCC) as sponsored by the ARRL. In fact, one could work 100 grid squares during a summer Sporadic-E season on Six, particularly if you operate in the June ARRL VHF Contest. It is easier to obtain a VUCC award on Six Meters as opposed to working all 50 states or working 100 countries. Just like the HF band, Wyoming on Six is very rare! The introduction of the VUCC award and also the VHF contest restructuring has contributed to the recent increase in activity on this band as the word is spread.

On Six, hams are talking about working rare grid squares as if they were talking about chasing rare DX countries. Here too, is a new opportunity for stateside hams to engage in a DX expedition of sorts by traveling to and operating from a rare grid square. This is commonly known as "mountain-topping" or "hilltopping." The nicest part about this type of expedition is that there is only the cost of gasoline for one to drive to a high hill in a rare grid. For such a small cost, one could easily be as popular as a 3Y5 or a 3W8 DX station by operating in a rare grid such as DL88 or EL79. One will get to know which are the rare grid squares, but typically they are usually in sparsely populated areas, particularly near mountain ranges or in areas where only a small bit of land exists along the ocean. This activity occurs a lot during the summer, particularly during VHF contests.

Besides the introduction of the ARRL VHF/UHF Century Club program in 1983, the League has restructured its VHF Contest to using the grid square system as part of the exchange. There are three VHF contests throughout the year that are sponsored by the ARRL. They occur on the second or third weekend during the months of January, June and September and encompass a day-and-a-half time period on all VHF bands including Six. Individual band awards and All Band awards are available for each ARRL Section. The action can be fast and furious when a

Figure 6-1



ARRL Grid Locator for North America

Sporadic-E opening occurs during a contest, particularly during the June event when more stations are on. As Field Day is also in June, this is a good chance for checking out the Six as part of your Field Day exercise. All too often, radio clubs tend to put less effort into setting up a VHF station for Field Day. This is a mistake as a good Sporadic-E opening on Six as well as good local capabilities can make it worthwhile. Another contest to look for is the Six Meter Sprint which is held in May.

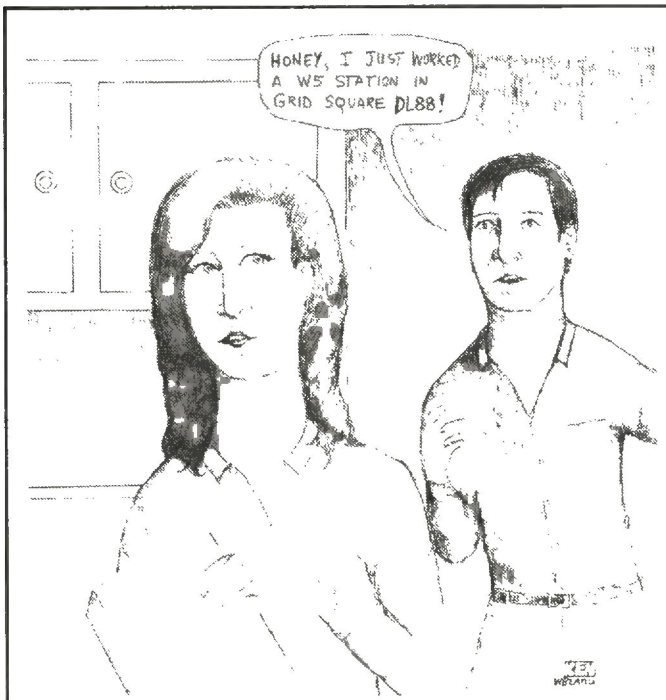
As with 10 Meters, there are a number of ham organizations that are dedicated to Six Meters. For example, a number of Six Meter operators belong to SMIRK, the Six Meter International Radio Club. SMIRK numbers are assigned to members like Ten-Ten numbers are assigned to members of the Ten Meter organization. There is also a SMIRK contest which takes place on the third weekend in June, in between the ARRL June VHF QSO party and Field Day. The purpose of this contest is to promote activity on the band in the midst of the Sporadic-E season. There are other Six Meter organizations which one can find out about through contacts with other Six Meter operators.

One may ask if DXCC has been accomplished on 50 MHz. The answer is yes, as over 150 amateurs from around the world have qualified for this award. Stateside stations comprise the largest percentage of those achieving Six Meter DXCC with 40 percent. Almost 30 percent are Japanese radio amateurs. One can see that Six is very popular in Japan as equipment on this band is readily available and because there is less of a TVI problem since television there is in the UHF range. The most countries worked at this point is by a few Japanese hams who have 150 countries, so you can see that Six Meters has a good worldwide presence. Worked-All-States (WAS) has been accomplished on Six, however Wyoming is as rare on this band as it is on others. So consider a grid square expedition to Wyoming as part of your next summer vacation!

Six comes as a pleasant surprise to newcomers who may have spent a number of years on the HF bands, particularly when they monitor the band during the heat of a Sporadic-E season. I heard one ham exclaim how much more fun he was having on Six chasing new grids as compared to working over 275 countries on the HF bands. Part of this is attributed to the misconception that a lot of hams have had about the band being a dead band. However, by focusing on Six during the active times, one can have a lot of fun working

new grid squares or countries. Certainly, it is not a given that one works long distance work on any day as the band is frequently quiet, so the challenge is there for hams to be around to catch openings when they occur. An opening from the East Coast to Europe is a standard occurrence on 20 Meters, but on Six such a happening is a very special event which draws oohs and aahs from your ham radio peers. Six can grow very quickly on a newcomer to the band, almost to the point of obsession. Six Meters is proving to be a viable band for filling in the gaps for HF operators during the dog days of summer and during the low sunspot count years. As hams buy the newer HF rigs that include Six as an option, both the popularity and fun will increase.

There are a number of sources where hams can read current information about Six with regards to DX, and long distance work. Packet clusters can provide recent daily information as hams report any band openings as they occur. The major ham radio magazines have dedicated monthly columns to VHF of which Six Meters is a regular part. In addition, there are special newsletters dedicated to just VHF or Six Meters and these are listed in the appendix of this book. One can see the reports of other active operators on Six and look for these callsigns during an opening to their direction. All are encouraged to submit reports of skip activity to these columns. It becomes easy to remember callsigns on Six after you worked them a few times during the various openings. Six becomes more of a fraternity than the other Amateur Radio bands. One can gain useful hints or technical information from fellow Six Meter operators who may have had similar problems as you with equipment or TVI. They can give you the benefit of their experiences in solving these problems.



New lingo is introduced into the Six Meter operator's house.

For many years, there was a noticeable lack of DX stations on Six Meters. This was because many countries did not allow their Amateur Radio population access to The Magic Band. Reasons for this were that other services were on this band and also because of TVI concerns, particularly on the European continent where TV Channel 1 was being used. This was very frustrating to European hams who were very much aware of the capabilities of Six through the use of cross-band QSOs conducted on Six and Ten Meters. This setup would involve United States hams transmitting on Six and listening on Ten while the European ham would listen on Six and transmit on Ten. The first known completion of such as QSO took place in 1946 with a cross-band QSO between Ed Tilton, W1HDQ and D.W. Heightman, G6DH. This established the fact that Six had long range capabilities but it still frustrated the European hams that they were denied access to the band.

This frustration of not having 50 MHz privileges would continue for almost four decades. As long as Channel 1 was still being used, it looked bleak for the European hams. Imagine the longing that a British ham must have had for Six after completing several cross-band QSOs with the United States. By the 1980s, things slowly started to change with Channel 1 usage being phased out in Europe. Limited 50 MHz privileges were granted to British hams by permit only. The restrictions included severe power limitations and operators could commence activity on Six only after 2230 GMT. This was not an ideal situation, but a number of transatlantic QSOs were being made by the summer of 1984 via double-hop Sporadic-E skip, By the end of 1984, all Channel 1 activity had ceased in the U.K. and now Class A British licenses were granted full time operating privileges on Six.

Once the floodgates opened for the Europeans, an explosion resulted with Amateur Radio operators of these countries embracing this band wholeheartedly. With England becoming the first European country to get full 50 MHz privileges, Portugal would be the second country to do the same. With the inclusion of Belgium and Luxembourg in 1989, just about the entire European continent has access to Six. In fact there are more

The author, WB2AMU, in front of one of the rarest grid squares in the New York area (known as FN40) near Montauk Point, Long Island. Unfortunately, this grid square begins about ½ mile offshore and is accessible only by boat. There are many grid squares located in the ocean. A grid square expedition to them requires careful planning, accurate bearing determinations and a good-sized boat to negotiate the temperamental waters of the ocean. —photo by Fran Neubeck.

hams active in this area of the world on Six than in all of the United States. Quite a reversal in comparison to the HF bands! The increased activity in Europe coupled with the rest of the world has led to new discoveries about this band, particularly in the area of propagation.

One of the British operators that I have worked, Byron Fletcher, G6HCV, was the first British Class B licensee (VHF only) to obtain Six Meter DXCC and has worked 108 countries to date. He accomplished this feat using 50 Watts output from a ICOM-551 to a four-element Yagi in about a five-year period since 1987. At his location at about 53 degrees north, Byron gets a good mix of propagation with F2, Aurora and Sporadic-E helping him work into other countries on Six. He, along with other hams from the UK, is very enthusiastic about this band after years of waiting to get on.

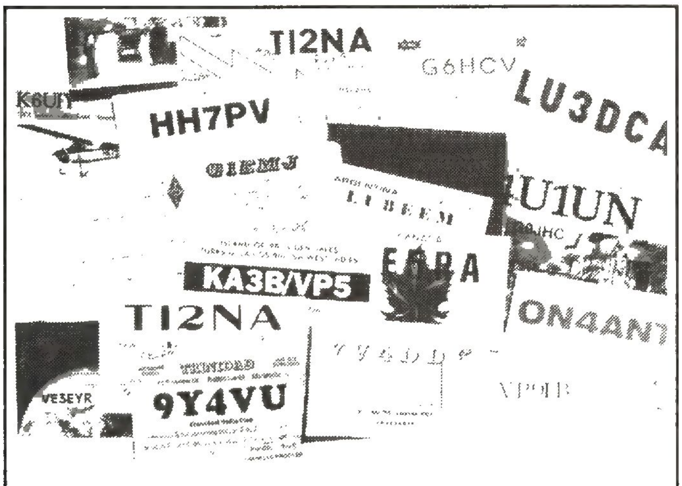
Japan was one of the first DX countries to access The Magic Band, utilizing it since the late 1940s. The fact that the Japanese TV bands are much higher than the United States and Europe has made it much easier for the Japanese hams to operate Six. In addition, commercially made 50 MHz gear in Japan has been manufactured in sufficient quantities over the years to keep the interest rate high there. The results can be seen by the fact that almost 50 JAs have qualified for Six Meter DXCC. Even when F2 skip condition fade during the sunspot minimum, double hop Sporadic-E keeps things interesting with QSOs between Japan and other parts of the world, including the United States.

When conditions are good and a DX station is calling on Six, a pileup can ensue. This can happen not only with a foreign station but also in the situation of a station operating from a rare grid square. As in the HF bands, you will not be able to hear many of the stations calling the DX station, so it is not always possible to gauge how bad the pileup is. I have seldom heard a DX station using the call area method to control pileups. This is because he is probably only hearing two or three different call areas anyway because of the nature of F2 or double-hop Es. On Six, there is seldom the amount of abuse on DX that you find on the HF bands. This is because of the smaller area of coverage during the skip, fewer stations on the band and because no station has a real advantage over the other. The latter is explained by the fact that if conditions are good on Six via an Es or F2 skip, no additional amount of power is going to give you that much more an advantage over another station. If the skip favors you, and you have a decent antenna setup, you have it made. If it doesn't, you will have a tough time beating out stations where the skip favors regardless of power levels. 160 Meters has been called the "gentleman's band" but I have seen some wild pileup scenes taking place there, so I think that this description better describes DX activity on Six. I have yet to hear the word "lid" used by anyone on this band.

Here is an example of the fun that can be experienced on Six. On January 5,1992, late on a Monday night, I was tuning around 15 Meters when I starting hearing relatively strong signals from the 8th call area which suggested the possibility of a "short skip" condition being present at my QTH on Long Island, New York. On a hunch, I fired up my Swan 250 and was surprised to find Six wide open with Sporadic-E skip. I worked Canadian provinces such as Labrador, and Quebec, as well as stateside into Minnesota and North Dakota up until past midnight with strong signals on both sides. I couldn't believe that Sporadic-E could occur this late at night in the dead of winter. Yet, there was more to come! On the following Saturday, I was listening at 10:30 in the morning on Six, when a super F2 skip opened up towards Europe and allowed me to work four new countries and six new grid squares. In less than 20 minutes, I was able to log in F6CER, PAØRDY, ON4ANY, G4ANT, GØJHC, G1EMJ, G6HCV and G1SWH with signal reports averaging at 5/7 or better. Many of the European sta-

tions were using less than 25 Watts. The next day, Sunday, brought in an incredibly long F2 skip from my QTH into California and Arizona and it lasted for the better part of three hours. In a one-week time frame, this quiet band was the hottest DX band around! It is of interest that I worked all stations using only a vertical antenna recycled from a car and modest power of 100 Watts output. This shows that DX on Six can be worked by anybody provided they pick the right time to listen.

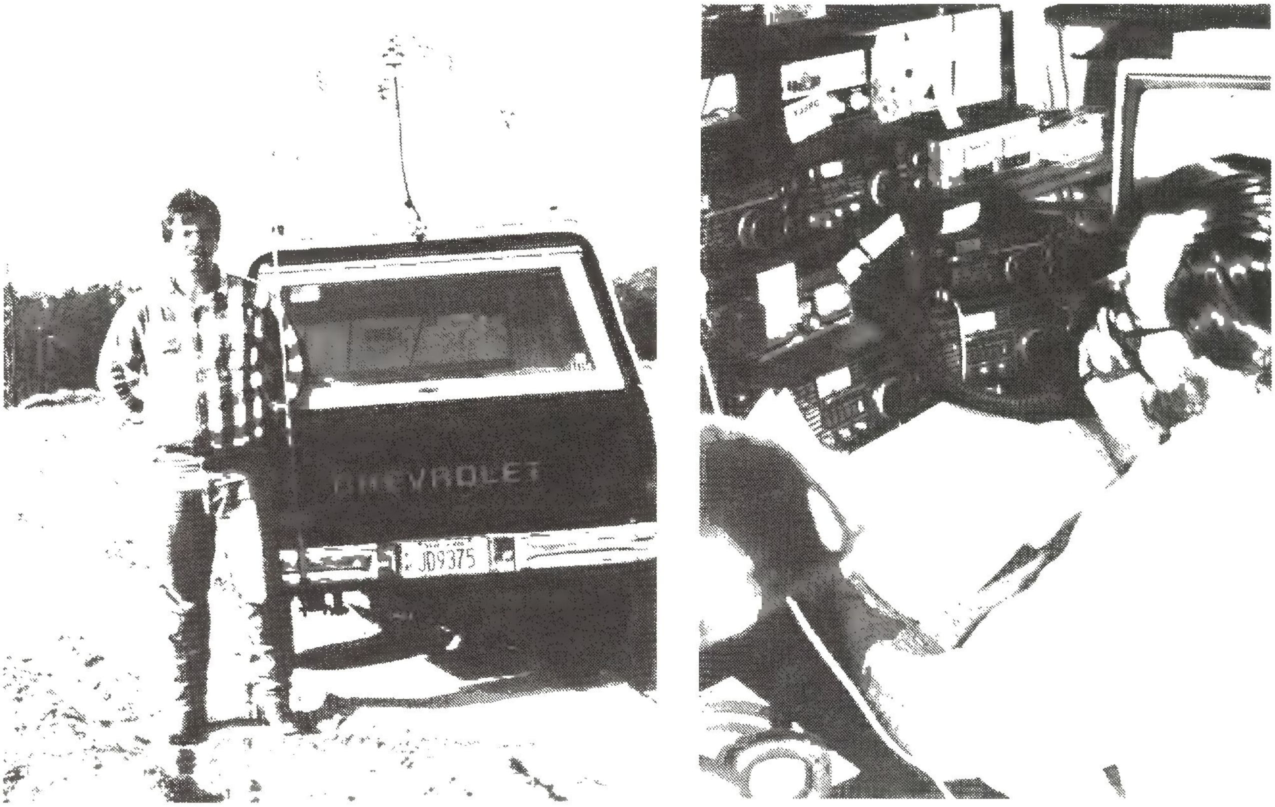
When the sunspot cycle is near the maximum, some pretty intense F2 openings can be experienced resulting in a lot of fun for those who catch this action. Did you know that a number of long distance QSOs have been accomplished between Australia and the United States on Six? A friend of mine, Frank Moorhus, AA2DR, who lives 10 miles east of me on Long Island, was able to accomplish this feat recently on October 29, 1991 with his mobile setup! Frank came home and started listening around 5:00 p.m. local time and came across a great F2 skip where he heard Ron Graham, VK4BRG from Queensland on 50.117 calling CQ. He returned the call and was able to get a good 5 by 9 report using his home station setup with a directional beam. What was more amazing was when Frank went outside to his truck and still heard VK4BRG with his mobile 100 Watt rig using a Saturn 6 antenna. Since no stations were answering Ron at this point, Frank gave a call and was able to work Ron again. Frank believes that this is a record for a mobile contact on Six Meters with over 12,000 miles between the two stations. Ron believes that on this particular day where he worked many other east coast U.S. stations, it was the result of a combination F2 and Sporadic-E skip. He believes that F2 skip allowed him to work into the W5 section and a Sporadic-E opening to the east coast completed the last leg of this path. Ron would again see a similar combined F2 and Es opening to the U.S. two weeks later where he worked into the western states up to Oregon via the Sporadic-E link to a F2 opening to the W5 area. Ron has also achieved a number of long path QSOs with stations in Africa on Six from his QTH. As you can see by these examples, it is not impossible to work long range DX on Six Meters as well as experiencing combined skip conditions of F2 and Sporadic-E on Six Meters.



QSLs for 20 Meter QSOs? No, these are some of the DX contacts made by WB2AMU via Sporadic-E and F2 propagation on Six Meters. —*photo by Ken Neubeck, WB2AMU.*

One of the veteran Six Meter DXers I met on the air has been Howard Grounds, W9JMS. Howard was one of the early users of Six when the band was opened to radio amateurs and has racked up quite a collection of DX contacts in the 40 years since then. Included in his computer base is a pair of SSB contacts made with Japan from his home QTH in Indiana during the last sunspot peak. Examining his list of 40 years worth of DX contacts, it can be seen that there are no DX contacts made during the sunspot minimum at any time via F2 propagation. However, Sporadic-E propagation picks up the slack during the summer months with contacts to Europe and the Caribbean with most of these contacts made via double-hop Es. One of Howard's greatest days was on January 6, 1992, when he made 22 European contacts, covering nine countries and twenty grid squares. There had been a tendency to erroneously classify the operators on Six as interested only in local work rather than collecting QSLs. While this is true in the FM portion of the band, those who use the weak signal portion of the band actually do exchange QSLs. I have found the response on Six to be better than the other Amateur Radio bands because many of the operators are striving for VUCC and other awards. A good rule of thumb is those who exchange grid square information are also generally those who would exchange QSL cards.

DX stations are also very good with their QSL responses. A number of Europeans I worked have mailed to me directly right after making the QSO. There is more status for me as a station from FN30 than as a W2 station. That is because FN30 is moderately rare on Six, particularly for new operators or for DX stations who do not hear stateside often. So the grid square is the driver for how rare or important you are rather than your country or state. Try operating from a rare grid square during a contest. You will see how full your mailbox can get! As a rule, it is a good idea to provide a self-addressed stamped envelope with your QSL to a DX station or one from a rare



Here are the two sides of a long distance QSO on Six Meters. Frank Moorhus, AA2DR (left), next to his Six Meter mobile setup with a Saturn 6 antenna with which he worked Ron Graham, VK4BRG (right), at his QTH in Queensland, Australia in October 1991. — photos courtesy of Frank Moorhus, AA2DR and Ron Graham, VK4BRG.

grid square. Some of these stations may work over 100 stations during a single opening, so return postage would be most helpful.

Unlike the monthly propagation charts that are listed in the various Amateur Radio magazines, there is no standard propagation chart that can be used for Six. Sometimes, during peak sunspot activity, these charts may show the Maximum Usable Frequency (MUF) reaching 50 MHz at certain times of the day between two specific locations. However, this only happens during very high sunspot counts and is not always accurate. Be aware that the MUF described in these charts applies to F2 layer propagation, and not to E layer activity where Sporadic-E occurs.

However, there are general guidelines that can be followed by 50 MHz operators that can maximize their success rate in working DX. It's important to know that DX is possible even if the sunspot count is low, because Sporadic-E can make great things happen. First of all, during the two years preceding and the two years after as well as the year of the sunspot maxima, one can expect occasional F2 propagation during the months of October through early May. These openings tend to follow North-South paths the majority of the time but this is not a set rule. Both single-hop and double-hop Sporadic-E can make DX possible during the summer and winter season with double-hop Es occurring more often during the summer months. Sporadic-E is independent of the sunspot count and F layer activity as it occurs in the E layer so one would not expect this activity to decrease from year to year. The month of June in the Northern Temperate Zone is an excellent time for double-hop Es skip and possibly good DX. Again, direction is hard to predict for Sporadic-E as it is for F2 propagation and there is no real rule for what direction to monitor on a regular basis. Aurora and Trans-equatorial openings tend to happen in the late winter or early spring when they do occur and DX is possible here, too.

Besides monitoring 50.110 and 50.125, operators should monitor 28.885 for information on Six from DX stations. Here, schedules can be set up as well as an exchange of information on what the other station is hearing on his end, on The Magic Band. One will be surprised at the amount of activity on Six that is occurring worldwide even when the band sounds dead on your end. A

number of packet cluster nets routinely cover openings on Six, however, if the opening reported is a Sporadic-E opening, it may not necessarily be open towards your area because of the limited size of the E-cloud. It can give you an advance warning that a Sporadic-E opening may soon ensue in your area. However, it still pays to routinely monitor the 50 MHz calling frequencies for any openings. One trick to use when monitoring if you have two VFOs built in your rig is to set the frequency of one VFO in the beacon range while setting the other VFO near the calling frequency. This allows for quick monitoring of two frequency ranges just by the touch of a button and that is very useful during rapidly changing band conditions.

To summarize, one should not listen to the uninformed and put the rig away just because the sunspot count is low and F2 propagation is non-existent. Such would be a grave mistake! The Sporadic-E season allows for excellent long-distance work to be accomplished particularly when double-hop E-skip occurs. Sporadic-E is generally consistent throughout the lean and peak years of the sunspot cycle. As a rule of thumb, DX operators in the northern hemisphere on Six should listen during the fall and winter months of October through February when the sunspot count is high and all of the time during the summer months of May, June and July for their best chances for working DX. This is taking maximum advantage of when Sporadic-E and F2 skip occurs. Other modes such as Au and TE can fill in at other times but when they will occur is harder to predict. Daily monitoring is still recommended if you are looking to work stations via these modes of propagation.

Chapter 7
The Curse Of The TVI Band

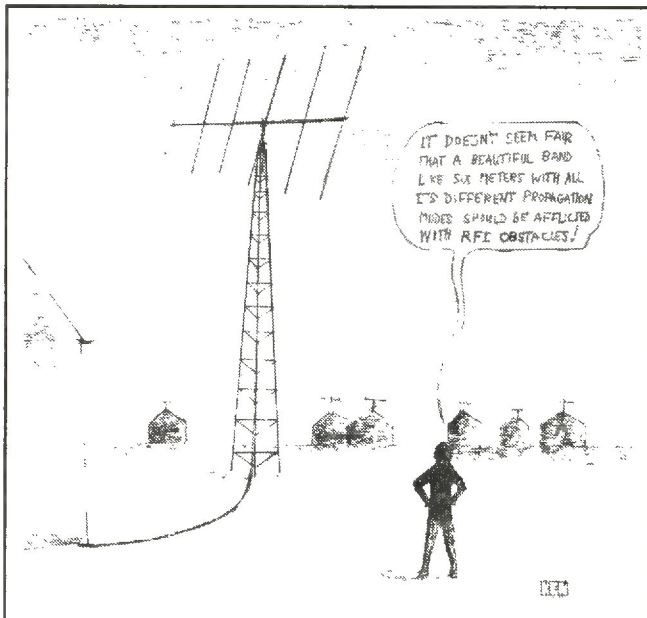
It really isn't fair, but Six has always been dubbed the "TVI band" since its inception, and it still hasn't shaken off this label. No discussion about Six Meters is complete without an in-depth look at the inherent TVI and RFI problem. This problem has haunted the band from the start in 1946, when the FCC first put hams on Six. The TVI problem has made Six a "forbidden band" on which hams are made to feel guilty operating. The location of a ham band in the 50 to 54 MHz range is a more severe situation than the second harmonic interference on Channel 2 caused by Ten Meter operation, because the fundamental frequency on Six is so close to the 56 MHz Channel 2 band edge.

Even the introduction of cable TV has not eliminated this problem entirely as there are leakages associated with cable lines. You can usually find a severe cable leak by listening to 145.25 MHz on a Two Meter radio. This frequency is in the middle of Channel 18 which is part of cable TV coverage in most areas. If you suspect that you have a cable leak in your neighborhood, you should get in touch with the engineering department of the cable company that services the area. A friendly letter with pertinent details along with a map showing the areas of leakage will make headway with the cable TV company. Remember, they have to comply with FCC guidelines on signal radiation and they have to worry about possible interference to other services such as the aircraft radio band. The letter approach works better for initial contact with them. You should stress that you are willing to help them in any way since a properly operated cable TV system will benefit both the ham and the cable company.

Also, some rigs may overload the TV due to TV receiver design faults and our Six Meter power levels. When I first got on Six with my Swan 250, I thought since I had cable in the house, I should have no problem with the TV. Imagine my surprise when I was informed by my XYL that I was getting into the set. Six Meters is also brutal to portable phones and broadcast AM and FM radios. It is a problem of wide scope.

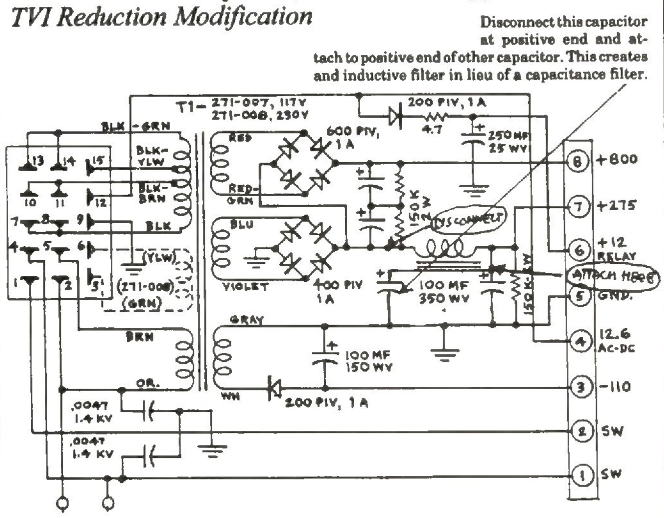
I can tell you many horror stories with regards to Six Meter TVI problems. Sometimes the ham is erroneously blamed for RFI when it was really another source. I knew of a ham on Long Island who had a couple of tall towers over 50 feet in height. Unfortunately for him, there were a number of CB operators in the neighborhood who were operating equipment in excess of the legal power limits for CB. Needless to say, there were a number of RFI complaints regarding TVs and phones. So who did they blame? Of course, the Six Meter operator with the towers. The problem resulted in the FCC making a number of visits to verify that this ham was not the source of the RFI problems on Six Meters or any other frequency. The ham even had difficulty with his ham radio organization, who had erroneously chose to side with the neighbors instead of defending him. It is a no-win situation when there are RFI complaints and you have these tall towers in the backyard. This sad story ended with the ham moving away. Unfortunately, even if you are right, you are perceived to be the source of the problem and towers are the first thing neighbors see when looking to assign blame.

From experience, I can tell you that there are certain approaches that one is better off taking with regard to this problem. First of all, make sure that you do not have a problem in your own house. If you are running clean in your house, it would be difficult to make a case against you. Secondly, do not draw attention to yourself in any



The trials and tribulations of the Six Meter operator.

Swan Model 117-X (230-X) A.C. Power Supply
TVI Reduction Modification



Unfortunately for operators of the Swan 250 rig, there are some inherent problems with it. Besides a significant VFO drift problem, the rig will generally cause severe TVI and RFI. One problem is the separate AC power supply (model 117-XC) using less than ideal practices in the circuit design. This was discussed in the April 1971 ***Ham Radio,*** "Television Interference: an Effective Remedy." *One suggested change was to clip the input capacitor on the input filter. However, after some experimenting, we have found that it made more sense to reconnect this capacitor (see schematic) to the other capacitor making an inductive filter instead of a capacitance filter. The inductive filter uses RMS power instead of the peak power that is used by the capacitance filter, thus reducing power by one-third and also making for a cleaner signal output.*

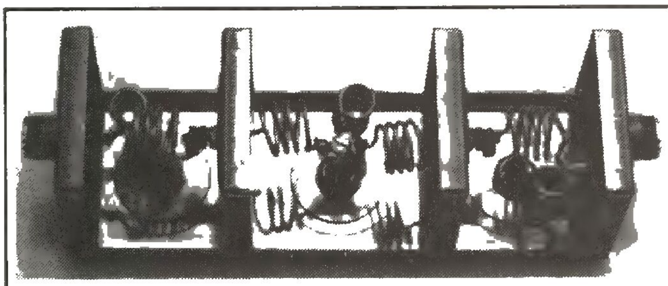
way. Do not tell your neighbors that you are a ham radio operator and say to them, "If you have any problems with interference, let me know." You may have the best intentions but you will be getting in a situation that is more than you can handle and you may eventually be blamed for all RFI problems, even when it is not your fault. Word gets around quickly about who the ham in the neighborhood is. Some radio organizations and other hams may recommend that you be upfront with your neighbors but you will have to be prepared to fix every problem that comes up. Even if you decide to put high-pass filters on all of your neighbor's TVs, you may not fix all RFI problems and you may also be blamed for any problem that develops with the TV set. What if the problem is caused by a fundamental overload or by cable TV leakage, what do you do then? Also be aware that even though as hams we love towers, it becomes a source of free unwanted advertising that you might be a source of interference in the neighborhood, so think this out carefully. Sometimes, a low profile is the way to go when starting out as you really should want to avoid ugly confrontations with the neighbors.

The ARRL Field Organization calls for the appointment of a Technical Coordinator in each ARRL Section. The Technical Coordinator can be called in to act as an interface between you and your neighbor when an RFI problem arises and cannot be resolved in a simple matter for whatever reason. However, he can only make recommendations and cannot legally go in and do things like installing high-pass filters on your neighbor's TV. Hence, it is to your best interest to resolve as much as you can prior to calling in outside help. Do everything that is required to make sure that your signal is clean in your own house before attempting to tackle problems in your neighbor's appliances. Use a Technical Coordinator only as a last resort.

There are many approaches to alleviate or reduce RFI problems. Many methods are described in books such as the *ARRL Radio Frequency Interference Handbook*. However, as Six is a special case that sometimes requires more work, the following are some steps that can be taken to alleviate the RFI problem.

1) Proper Filtering

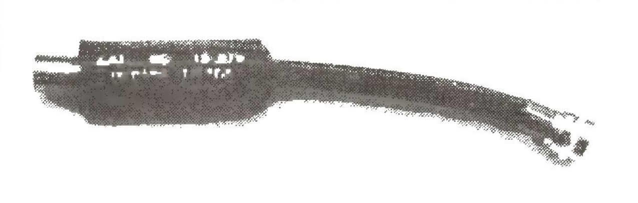
As a minimal requirement, your rig should have some form of low-pass filter, either built-in or externally installed. An externally installed low-pass filter on the rig with a cut-off frequency of 54 MHz will help if the interference is with the lower TV channels. Many of the newer rigs will have built-in low-pass filters in them due to FCC requirements. For example, a number of the Kenwood and Yaesu Six Meter rigs have low-pass filters in the final output stages. Many of the older rigs, such as the Swan 250, were designed without properly addressing interference problems and this shows up immediately. The addition of either a Drake or Barker & Williamson low-pass filter may help with these rigs, however, sometimes substantial modification may be nec-



The inside of an external low-pass filter with design cutoff at 52 MHz. A low-pass filter may not be as effective on Six Meters as it is for the HF bands if the interference is caused by fundamental overload. That is, the front end of the television is not able to reject the signals of nearby Six Meter signals. — *photo by Ken Neubeck, WB2AMU*

essary to the rig. In the case of the Swan 250, I found that changing to a capacitance input in lieu of the existing inductive input filtering in the power supply was a major step towards improvement as inductive inputs are more susceptible to causing RFI problems. However, it may come to a point where you will find out that older rigs such as the Swan 250 are not RFI-proof despite all of your efforts because of the way that they were designed. Thus a newer rig employing an internal low-pass filter becomes a logical choice.

As a rule, high-pass filters should also be installed on TV sets, including cable fed TV sets which can use a coax type filter. These are easily found at Radio Shack and similar stores. These filters are a very simple installation for anybody. If a neighbor feels that he does not want it anymore for whatever reason, he can easily remove it by hand or with a screwdriver. A high-pass filter is essentially a "no brainer" fix and it can't hurt to put it on. However, be aware that neither a high-pass nor low-pass filter will help that much if the problem is due to a severe fundamental overload.

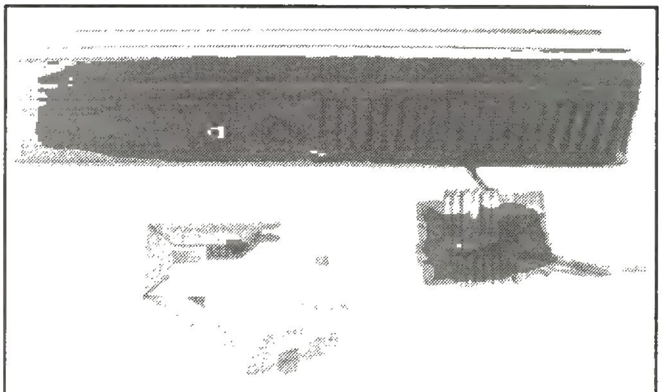


A typical high-pass filter that is sold in electronics stores. This particular model is designed for cable television sets. — *photo by Ken Neubeck, WB2AMU*

Along these lines, make sure you have a good earth ground for your rig. Try to find a short path between the case of your rig and a cold water pipe and use braided cable or thick wire to make the connection. Sometimes the pipe of a water well is a good choice. Also, cut a piece of wire that is a quarter-wavelength long and attach it to the grounding post of the rig to act as a counterpoise. These things may not fix an existing problem but they can't hurt.

2) RF Chokes

For situations where all channels are affected, a possible cause is fundamental overload that is causing audio rectification in the TV circuits. A form of common mode rejection is required to prevent this problem. Such can be accomplished by the installation of ferrite toroid RF chokes on the TV power cord and the coax input of the TV set. These chokes can also be used on the power cord of AM radios where it is easy for RF energy to travel on the outside of the wires into the device. These chokes can be purchased from Radio Shack or other electronic stores with complete installation instructions. Also, old ferrite transformer cores can be used. The coax or power cord should be wrapped several turns around the choke or core. You may have to use several chokes on the appliances in your house particularly if there is a VCR or a phone packed with electronics. Another way to reduce power line RFI is to run the transmitter off a DC battery instead of an AC power supply.



The installation of an RF choke is shown here on the power cord of an AM/FM radio. The choke should be placed as close to the radio as possible with many turns of the cord wrapped around the core. — *photo by Ken Neubeck, WB2AMU*

3) Optimum Antenna Setup

There is an optimum height in the efficiency and angle of radiation for antennas, likewise there is an optimum height and location for antennas for RFI prevention. Those who use rotatable beams will tell you of problems with TV sets when their beam is headed in the set's direction. Beam users should be aware of these limitations. For other antennas such as verticals and dipoles, it is desirable to get the antenna as high and far away from your house and neighbors' homes as possible to reduce RFI impact. If your antenna is higher than any other antenna in the neighborhood, you would essentially be at optimal height, although this may not always be practically possible. Try not to have the front of your beam facing in the line of sight of a nearby house. A beam facing directly at a second floor window of a nearby house is not a smart idea either for preventing RFI or for optimal signal.

Another step to take if you are in a neighborhood that has a lot of television antennas (i.e. no cable TV) is to change the polarization of your beam from horizontal to vertical. According to Mitchell Lee, KB6FPW, by rotating the beam to

vertical, you will get at least a 10 dB rejection in the amount of unwanted RFI. He points out that there is no change in signal strength at the receiving end and this step can mean the difference in using 10 Watts or 100 Watts.

Avoid having antenna feedlines anywhere near the cable and telephone lines in your own house. As stated before, a beam on a tower will be conspicuous to the neighbors and it will be difficult to explain to them why a high tower is ideal in preventing interference problems. So make sure your RFI problems in your own house are minimal with any new antenna setup before you operate on this band on a regular basis.

4) The Right Power Level

If you still have problems after using the previous steps, the reduction of power may be necessary. Low power may be the best solution for any ham faced with a TVI problem. All too often, hams forget about using the minimal power necessary to make contacts and this is especially critical on Six. There are hams who run kilowatt power when they know that they have problems with their neighbor's TV set. Running a kilowatt on Six in any crowded neighborhood is asking for trouble and almost suicidal due to the increased probability that cheaply made TVs or radios are present. Remember, not all neighbors will be cooperative and they may call the FCC to investigate you.

The use of high power really does not make any sense because as on Ten Meters, when Six is open, modest or low power is more than sufficient to make contacts the majority of the time. Most of your gain should be in the metal or in the antenna rather than in the rig. Ten Watts to a five-element beam can be just as effective as 100 Watts to a dipole. For most of the hams on Six, low power and a beam seems to be the best combination. During most Sporadic-E and F2 openings on The Magic Band, you will be able to make a good number of contacts using lower power levels and you will feel relieved at the same time that you are less likely to be causing TVI.

Here is a real-life illustration of using the correct power level. During the heat of the Sporadic-E summer season in July of 1993, I was able to complete a contact from my location in Long Island to a ham in New Orleans by using my FT-690 II with an attached whip as an antenna using only 2½ Watts! Later that day, I worked a local ham who told me that he recently sold his linear amplifier because he was not satisfied with the power output of 150 Watts! This floored me! He was getting another linear that put out over 500 Watts despite the fact that he had a known problem with his neighbor's TV set due to cable line leakage. He told me that installing a high-pass filter did not help the problem when he was running 150 Watts out. I asked him why he felt the need to go to even higher power on Six when he had an existing problem with the cable TV lines in a dense suburban neighborhood. He couldn't answer me and I felt he really did not have a grasp for the band conditions along with the principle of using only the power level that is necessary. I felt that the ignorance of this ham was only going to hurt the hobby in the long run. The message is: if you live in a sparsely populated area and have no apparent RFI, you would be able to run higher power. Otherwise, if there is a possibility of a problem, it pays to be prudent.

5) Last Chance Options

It is still conceivable that one will still have a severe TVI or RFI problem even after having implemented all of these fixes. This may be particularly true if you live in a densely populated urban or suburban area. It is at this point that the ham self-impose "quiet hours" of operation for when he will be on the band. This would typically be to operate only during early morning or late night after prime time TV watching. This is a difficult situation for any ham to live with. However, a more viable option is to do portable or mobile operation away from your neighborhood. This option includes portable operation in public park areas or more remote locations away from TVs, stereos and radios. This option is particularly more viable on Six than on the HF bands because it is not difficult to construct and use efficient antennas that will work well even in a mobile setup. See the chapter on mobiling for more details. Remember, a simple quarter-wave vertical for Six is 56-inches long and will work well. You can pick and choose ideal sites such as hills to operate from that will maximize your station's efficiency. It is not difficult to find a number of sites that are far away from TV sets. Even the parking lot of your work QTH during lunchtime is a good choice, particularly if it is in an industrial park, as there are less appliances in the area to worry about. I've found that this option is especially enjoyable in breaking up the workday, especially when a good opening develops. Consider that if you do all of your operations away from your house, you cannot be held responsible for possible Six Meter interference problems in your neighborhood.

To further illustrate this point, at least one-half of my contacts on Six during the 1993 summertime Sporadic-E season were made away from my home QTH. I had a mental list of at least five or six ideal locations (besides my work QTH) that I found suitable for mobile or portable operation. I found ideal sites to be at a public parks or beach parking fields during the slow times such as weekday nights. Typically, most of my operations were about an hour, so there was no fear of running the car battery down. I was able to run more power than I could at home where RFI problems would occur when I ran more than 10 Watts output. Typically, I would run 60 Watts and get more than satisfactory results in the number of contacts I could make. By the way, this can be done for other HF Amateur Radio bands besides Six. However, it seems to me that it is not too difficult to put up a vertical or attach an amplifier for instant operation on Six Meters for trouble-free operation.

It is a good idea to periodically check your setup and see if it is causing problems in your house. Sometimes subtle changes in the house will make a problem occur or get worse. Usually, it is a good idea to check things when nobody is around. Turn on the radios and the TV sets that are used and first see if there is any problem with your setup when loading into a dummy load. If there is, start trouble-shooting in the area of your transmitter. If this step is not a problem, put your key down in the low power position and see if any problem exists. Again, troubleshoot if there is a problem. Next find what power level you can safely use without causing a problem on the TV set or radio. With regards to phones, the newer portable phones have circuits that are particularly susceptible to radio interference. Believe it or not, the older carbon-type phones are better able to withstand this type of interference. See if you can use such in the house if you have a problem. Granted, they may not look as nice and you can't carry them around, but until better phones are made by manufacturers, these are the steps you must take.

Another thing to mention is the fact that different sources may cause interference to the 50 MHz operator's receiver. Ignition noise is a common irritant and most of the newer rigs have noise blanker circuits that can fix this problem. Sometimes, one may find some unusual carriers on Six that do not sound like they are ham radio related. This is particularly true if you are operating near or in an industrial area. For years, in the industrial park where I work, I have found a carrier that was on 50.030. Using my portable rig with telescoping antenna, I was able to isolate the problem to a specific building in the industrial park. I moved my setup away from this building when operating to avoid this interference condition. The 50 MHz range is also susceptible to computer noises so filters may have to be installed on the computer if one desires the computer to be on when operating.

Remember, if you have an interference problem, it will not go away by itself, so it is best to explore the various options to solve this problem and avoid nasty incidents with your family or your neighbor. The existence of this problem should not deter the ham from operating on this band, nor should the ham be scared off by other hams saying that Six is simply a "TVI band" that does not warrant any further interest. Actually it can provide a challenge to the ham to find ways to deal with the problem and to be able to enjoy operation on the "forbidden" Six Meter band worry-free.

Chapter 8

Going Mobile and Mountaintopping On The Magic Band

There are a number of unusual looking trucks in the area where I live in Long Island. These trucks have some unusual VHF antenna arrays on their rooftops and go by the nickname of "porcupine" trucks. These trucks are owned by friends of mine such as Frank Moorhus, AA2DR and Ron Beausoleil, N2NBY, and they operate Six Meters as part of their mobile operations. Mobile setup such as these are not only used for daily work on Six but also for contest work and for traveling to rare grid squares. Because of the small wavelength, 50 MHz and mobile operation are an excellent duo that work well together.

The equipment setup for mobile operation is straightforward. The most important thing is to have a direct line from your rig to the battery terminals of your car. Some people may take shortcuts and attach to the battery via the cigarette lighter which generally works but this is not desirable for a long-term setup. You would want to have a setup that is strong and will last awhile. Hence, use wiring of fairly thick gauge. Do not use flimsy wiring. After all, you have made a sizeable investment in your equipment and you don't want to blow it all by using shoddy wiring or a flimsy setup. Additionally, if you clip on your rig or amplifier directly to the car battery when in the portable mode, always do a double take when connecting the wires to the correct terminals. Fortunately, with the newer rigs a mistake may only result in a blown fuse or a burnt protection diode but even this is not worth making a mistake. Having permanent wiring in place would be one way to avoid an error of this sort.

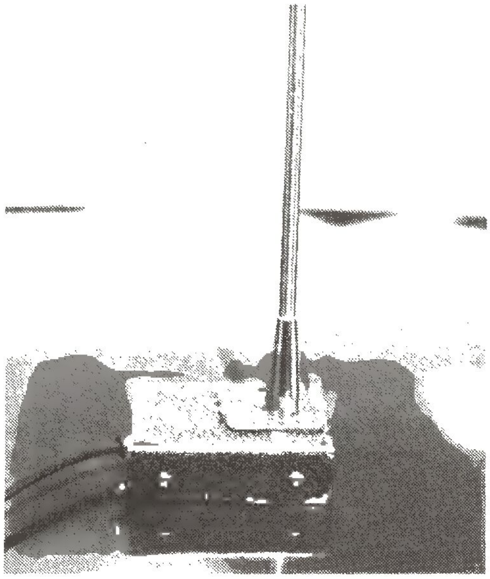
Perhaps the biggest problem in mobile work is where to put in a permanent mobile setup or mounting bracket. Unlike antennas where you can use magnetic mounts or clip-on hardware, you will have to drill some holes to put in screws for the mounting hardware. You also have to be aware of what wiring or equipment may be behind the console where you plan to attach or install your transceiver. Consult the maintenance manual for the car before you start drilling. With the rigs becoming smaller, this is not as big a problem when the transceivers were much larger. Just examine an old Heathkit SB-110 advertisement which shows the mobile installation of this rig and you will realize what a long time it has been since those days.

It is important to be aware of the current drain of your mobile station. Certainly, your setup should not cause an excessive drain problem when the engine is on. You can operate when the engine is off but it pays to periodically check the engine by turning over the starter and letting the engine run. Many of the new rigs draw less than 5 Amps for 10 Watts output and less than 1 Amp in the receive mode. This is well in the range of most car batteries for short operating periods of an hour or so with the engine off. One can run a series of quick calculations using an estimate of 40 percent duty cycle for transmitting and 60 percent receiving to give an idea the total amount of current drawn in one hour.

How elaborate an antenna system for your mobile setup depends on how much area you have available on your roof. Most pickups and vans have sufficient room for elaborate vertical phased array systems. If one does not have a large vehicle, one can put up at least a vertical or a halo antenna. Verticals should be placed in the middle of the car's roof for maximum signal strength. If you don't want to drill holes in the roof, you can use a magnetic mount, however choose a strong magnet with sufficient protection that won't scratch your car's roof. A bumper mounted antenna wouldn't be a bad idea except that most bumpers in cars today are not made of metal! That eliminates the source of a good ground. A ground attachment to some part of the metal body is required if using a vertical ground plane antenna.

There are some differences between operating on Two Meters and operating on Six Meters while driving. On Two Meters, you may have the repeater frequencies programmed into your radio, where as in Six, you may be monitoring 50.125 but you still will have to tune around when stations operate off of the calling frequencies. If you are distracted too much from tuning around, it may be best to pull off the road at this point and operate. This is probably the best thing if you are in a CW QSO. Also be aware that many states outlaw the wearing of headphones while driving.

In general, what is the best mode for mobile work? At this time for Six the answer looks like it is in the SSB portion. I would love to tell you that Six Meter FM is as popular as Two Meter FM.



A closeup shot of the magnetic mount that can be used for a Six Meter mobile quarter-wave vertical.

—photo by Ken Neubeck, WB2AMU.

Unfortunately, this is far from the truth for much of the United States. A casual glance at the *ARRL Repeater Directory* will show that there are over 150 pages of Two Meter repeater listings in the United States as opposed to only 13 pages of Six Meter repeaters. To illustrate the disparity between Two and Six Meter FM, in the Long Island area where I live, there is only one Six Meter repeater as opposed to 30, Two Meter repeaters. Some areas of the country have modest Six Meter FM coverage such as parts of Florida and California. Would you believe that there are no Six Meter repeaters in almost 10 states and only one Six Meter repeater in another ten. There is a big hole in the middle of the country as far as 50 MHz FM repeater coverage goes.

The situation is changing in some areas. However, in California, a revised band plan has put repeater frequencies in the 51 MHz region as opposed to the 52 to 54 MHz range. The further distance from 51 MHz to the low end of Channel 2 (56 MHz) has helped reduce TVI concerns. This is leading to a modest growth of repeaters in California where the current numbers have exceeded 50 repeaters. California benefits from decent tropospheric conditions which also extends repeater coverage. The repeaters in California employ a 500 kHz split between the transmit and receive frequencies as compared with the 1 MHz split used in other areas of the country.

What is the basic problem? Believe it or not, there is a fair amount of equipment for Six Meter FM, as in addition to FM gear made by Japanese companies, there are Six Meter FM HTs made by a number of American companies. The problem boils down to the area of education and desire. The bulk of the hams using VHF bands have to be exposed to the excellent capabilities that Six has for local work and the vast expanse of radio spectrum that it has to handle new repeaters. The band is just screaming for hams to take advantage of the nearly 3 MHz chunk of band space that is allocated for FM use. As it is, it is the most under-utilized amount of band space in Amateur Radio. Certainly, a little work is required to get a repeater on Six. Careful attention would have to be paid to RFI concerns, but at what point does Two Meters get too crowded and hams start checking out Six? The challenge is out there for those who want to use this viable FM network. The irony is that there were more Six Meter AM mobile stations on during the 1960s than there are Six Meter FM stations currently. It seemed like the transition was made from AM to SSB, but not to FM. There is more activity on the 50.125 SSB calling frequency than the 52.525, the FM simplex calling frequency.

Mountain-topping is an activity that is very common on VHF and it could be on the level of a simple mobile operation or a more elaborate situation as in a VHF contest. Even though in my area, there are no mountains, there are a few tall hills that fit the bill for such an operation. Other hams in other areas of the country can sometimes make use of a conveniently located mountain nearby. For a contest weekend, you may need other hams to help, particularly if you have more than one band that you are planning to use. Of course, the beauty of mountain-topping is getting away from crowded suburban and urban areas where not only can you enjoy the scenery, but you will have less RFI problems to worry about. Some planning may be involved and it is usually a good idea to scout potential sites ahead of time, prior to a contest. Some hams discover too late that there are some private lands nearby where people don't take kindly to hams, let alone strangers. It sometimes pays to have a backup site that you can go to if things come up unexpectedly.

The main advantage of mountain-topping is that a high location that you select will give you good line-of-sight for local contacts on Six. It will help on Sporadic-E and F2 skip but it is for local work where the effect is felt the most and for higher frequencies above 144 MHz. The idea of being on top of a high location is also a big psychological advantage as you feel that there is no reason why you can't work anybody during a decent band opening. You can get a lot of inquiries about what you are doing if you are in a public place. This is a good way to stress the positive

aspect of Amateur Radio. This is done routinely during Field Day but that is only one day of the year. If you are doing mountain-topping on a routine basis throughout the year, you will be in the public's eye more often. Hence, you are in a position of being a goodwill ambassador for the hobby.

Sometimes one may come across a desirable operating QTH that is not accessible by car. This is where a good portable station can come in. There are a number of low power Six Meter rigs that are portable enough that they can be carried easily, and use a low amount of current where a small battery can be used. One such rig, the FT-690, draws about one Amp of current for 2.5 Watts output or 4.5 Amps for 10 Watts output. This allows for either an attached battery pack option or a 6 Amp rated Gel Cel battery which can be carried in a small canvas bag. A telescoping vertical or a dipole can be put in this bag to complete the station. Images of hiking to remote areas with a compact setup on Six are a mountaintopper's dream. There is a QRP category in the ARRL VHF contest which encourages this type of setup. A number of hams participate in this way and have lots of fun.

The ARRL VHF contests have a "rover" category. That is, mobile or portable stations that will be traveling in more than one grid square during the contest period. Here is an opportunity for a mobile VHF operator to operate from more than one rare grid square and become the friend for many operators. Grid square hopping is a poor man's DXpedition and can be a great ego booster. Examples of the rarer grid squares in the United States that are accessible by road are the FN51 grid square in the eastern Cape Cod peninsula, the eastern Virginia grid squares of FM26 and FM27, EL79 in Florida and DM88 in the southern part of Texas. Other grid squares may require a boat ride such as DM02, San Clemente Island in California or FN40 off of Long Island. You will be surprised at how big a pileup you can generate when you operate from a rare grid square and how many QSL cards are in your mailbox a few days later. In comparison to a big time DX operation, the costs are minimal (or should be) and the enjoyment can be just as good. It should be realized that the grid square system is used at an international level as Six Meter operators worldwide follow the same system. So, a rare grid is just as important to foreign hams too.

Frank Moorhus, AA2DR, with his famous mobile setup which he used both for daily mobile work and contest activity. —photo courtesy of Frank Moorhus, AA2DR..

I have found that the mobile setup is great when I do local trips. Sometimes when I am waiting in the parking lot for my XYL, I can get a quick listen for any band openings by setting up the mag-mounted vertical. On other occasions, when I am at an all-day party during the summertime and it starts to get too long, I take a quick trip to the car and listen on Six. I generally run 10 Watts or less when I am in a strange neighborhood as I don't know if I may cause some RFI problems there by running higher power. This is particularly true when I made a few trips to the New York City area and I saw lots of TV aerials on the houses in the neighborhood. One time, I had to drive my XYL to a bridal shower that was over 40-miles away and this coincided with the January VHF contest. I looked on the map for a suitable park area where I could run a portable operation using a linear amplifier and a vertical antenna from my car. I ended up at a state beach and I spent three hours operating from my portable setup and making contest QSOs. Next time I think I'll bring my portable beam. For 144 MHz, mobile operation is already a normal situation. For a lower band like 50 MHz, this should also be a normal situation as it was many years ago for this band. Mobile work on Six should be more commonplace than it currently is.

Here's a form of mobile work that many hams don't usually think about. This is when you go on a business trip or a short vacation where you are renting a car. A lot of times, it's too much trouble to bring a transceiver, antenna, power supply, key and mike along for a business trip. However, I have found that carrying a simple mobile setup for these trips is not as much trouble as one would think. The portable Six Meter rig that I use, the FT-690 II, fits in my attache case and the other stuff that I need such as a telescoping vertical antenna and a linear amplifier fits in my suitcase. Since I prefer to carry my luggage on for short trips, this all fits in nicely. Since I was renting a car, there was no need to carry an AC

power supply and I could run the linear amplifier off the car battery. Allow yourself additional time when going through the airport security area in case there are questions about your radio. I find that having a copy of my license along with the instruction manual for the radio is good to have in case security is perplexed by what your radio is.

I found that it took little time to set up a modest 60-Watt station with a mag-mounted vertical in a rented car. This setup was sufficient for all local contacts and any moderate band openings. On a trip to Los Angeles, I worked a handful of locals in two grid squares from the parking lot of the hotel where I was staying. I missed an opening to Hawaii when I was there as the opening occurred when I went out to dinner. But it was nice to see that this setup worked well and I will definitely do this on a routine basis, particularly if I am traveling to a rare grid square. I found that operating out of the car gave me more freedom than operating out of the hotel room where certain logistical problems would have to be addressed. I could move my car anywhere in the parking lot or I could elect to go to a nearby hill or mountain. I would not have this choice if I had to operate solely out of a motel room. I could enjoy the best of all worlds by planning a mobile operation.

Boat mobiling can be a lot of fun for several reasons. If you are on a large body of water, there are generally no RFI problems to worry about. Secondly, as mentioned before, there are several rare grid squares which are only accessible by boat. A vertical mounted on a mast on the boat is a good antenna to use, and you can connect the ground plane side to any metal that is immersed in the water such as the rudder. This will give you a super ground. Line-of-sight contacts can be easier on a boat. Be aware if you are on a larger boat that has marine radios and depth finders, there may be some interference problems that will arise, not only to the boat's radio but to yours as well. Depth finders can generate harmonics that can cut up your 50 MHz reception. Besides using your radio for fun, it can be used as a backup for the on-board marine radio. For trips into the rare grid squares in the ocean, plan carefully and use a boat that is equipped properly for such a trip. This includes not only the required navigation equipment to determine where you are but also the required safety and emergency equipment. For some trips, renting a fishing charter boat might be a neat way to combine the two sports of fishing and ham radio.

Finally, it is important that the more proficient your mobile setup is, the better you are able to assist your community when emergencies arrive. Certainly, 144 MHz is the band of choice for hams involved in emergency work when a disaster strikes. But suppose the repeater is down or there is too much QRM on the frequency that you are using. Certainly QRM is a big problem to deal with on popular frequencies on Two Meters as well as some HF frequencies. Six has lots of room and is an ideal backup band which could be used for auxiliary communications. It is important to remember that Six was widely used as part of the Civil Defense network in the United States in the 1950s. There is no reason why it could not be used during an emergency that occurs today, given the excellent groundwave features that the band has along with the relatively simple mobile setups that can be employed. Set up a network of local hams who use Six prior to any emergency where you determine a calling frequency that can be monitored. Either FM or SSB could be used depending on what equipment the hams have. You will be providing a valuable service to the community when emergencies arrive.

Chapter 9

A Look Into The Causes Of Sporadic-E and Aurora Propagation

The causes of Sporadic-E propagation have been a mystery to not only hams but also to the scientific community. For several years, Sporadic-E propagation has been regularly observed by hams on the HF and VHF bands from frequencies as low as 21 MHz up to as high as 220 MHz. It is a common form of propagation on 50 MHz during the summer season with occasional openings in the winter months in the temperate zones or mid latitude areas of the earth. Six Meters seems to be the one Amateur Radio band that shows the most vivid effects of Sporadic-E propagation, particularly during low sunspot count years and when F layer propagation is not present.

A Sporadic-E cloud is scientifically defined as a plasma which is a collection of charged particles that when they form stratified layers, have the ability to reflect radio signals over a broad frequency range. These clouds are located in the E-layer of the ionosphere roughly 70-miles above the earth's surface. The composition of these clouds have been determined by numerous scientific rocket experiments to contain metallic ions such as sodium, silicon, magnesium and iron. The E-clouds have been measured to be only a few hundred yards thick and have an absence of ions such as nitrogen oxide and oxide that are normally found in the E-layer.

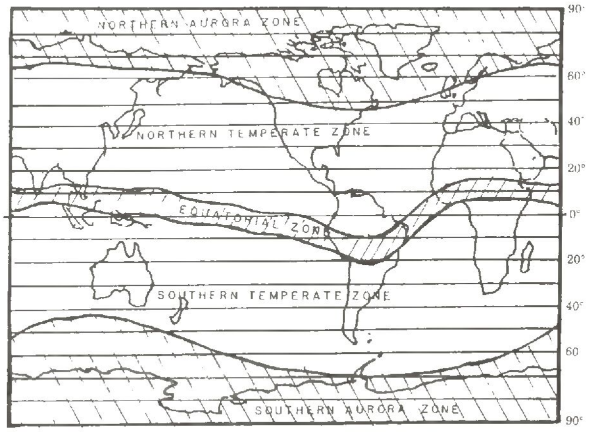
As opposed to F2 propagation, Sporadic-E events are local area events rather than entire regions. It can be observed that the activity that sparks Sporadic-E clouds on the earth affects the E-layer in spots as opposed to the sunspots affecting entire regions of the F-layer. The mass of charged ion particles will drift as the result of wind activity in the E layer and will eventually dissipate. The size of the Sporadic-E clouds can be determined by use of mapping midpoints between two radio stations. Sporadic-E clouds are by nature, very unstable. They rarely last for more than one day at a time and even though they may dissipate, the level of particle activity may be high enough for the cloud or clouds to reform again later on during the day or night. The E-layer of the ionosphere is apparently more accommodating for the formations of these types of ion clouds than the F-layer. The reasons for this may be attributed to factors such as temperature, density and atomic makeup of the E-layer, all of which are more conducive to the formation of Sporadic-E ion clouds.

Sporadic-E has been under scrutiny by the scientific community and hams for over 50 years. Many scientists have tried to correlate Sporadic-E to other natural phenomena. One theory has attributed E-cloud formation resulting from thunderstorm activity. Another ties it to the K-index of the sun. Yet there are many instances of contradiction to these theories over the course of a year's worth of observation. For example, not all thunderstorms bring Sporadic-E activity and not all Sporadic-E openings occur when thunderstorms are in the area. Additionally, it has been shown that there is no direct correlation between magnetic K data and Sporadic-E occurrences. Still another theory is the windshear theory which is based on vertical motion of charged ions resulting in the formation of E-clouds. Unfortunately, these theories can only explain certain aspects of Sporadic-E and still leave many unanswered questions.

Interestingly enough, Sporadic-E was a topic of discussion in the scientific community since World War II. As documented in *Sunspots In Action* by Harlan True Stetson (1947, Ronald Press), one of the factors that prompted the FCC to move the FM broadcast band from its original range of 40 to 50 MHz to its present day range of 88 to 108 MHz, was the presence of Sporadic-E in the ionosphere where it caused cross-station interference. Sporadic-E was a common phenomenon on the original FM broadcast range and it was felt that the shift to the higher range would help cure the problem. The book also states, "Furthermore, research has been made for relationships between the amount of Sporadic-E occurrences and sunspots, and the relation does not appear from present data to be a simple one." The book further states, "What may be the cosmic cause of such bursts, we do not know."

One of the earliest studies of this by radio amateurs on Six was published in the February 1949 issue of *CQ* magazine as "The Radio Amateur and Upper Atmosphere Research" by Oliver Ferrell, the *CQ* Assistant Editor. In this article, Ferrell documents a study of two Sporadic-E openings, January 8 and May 4 of 1948, using data collected by hams on Six. This predates many of the scientific community journals on the subject and is amazingly correct with many of the conclusions that are drawn from Sporadic-E observations on 50 MHz.

Figure 9-1



This shows the general zones for Aurora and Sporadic-E occurences as determined by scientific data. Note the deflection around the areas of the magnetic north and south poles for both Aurora zones. The Equatorial zone follows these magnetic deflections also.

Further investigations on Sporadic-E research were documented in Sporadic-E Propogation, edited by Ernest Smith and published in 1962. Smith determined that the earth could be divided into distinct zones known as the Aurora zone, the Temperate zone and the Equatorial zones as shown in Figure 9-1. In addition, many of the papers concluded that Sporadic-E propagation that occurred in these zones were caused by different sources. Many of the papers made use of the intense observations of radio conditions that had taken place in the late 1950s leading up to the International Geophysical Year (IGY) that took place in 1959. One study was conducted by Chadwick on determining whether there was any correlation between the sunspot count and Sporadic-E and he used data from three different locations around the world (Peru, Alaska and Washington). This data was all Sporadic-E openings greater than 5 MHz that were observed at these locations through the course of several years. He concluded that the results obtained "undoubtedly fail to represent the exact relationship between the variables" (sunspot count and percentage of Es openings). He cites earlier studies on the subject which yielded inconclusive results. However, the data he collected showed that Sporadic-E openings were constant in the area of the equator in which better than 90% of the openings occurring during daylight hours while other data from Alaska showed more Aurora type openings throughout the year.

The windshear theory that was developed by Whitehead states that Sporadic-E layers are caused by the windshear movement located in the E-layer of the ionosphere coupled with the accumulation at the shear level of an ion while undergoing atomic recombination. Although some relationship with windshear has been established, particularly with regards to direction and general locations of the E-clouds, not all Sporadic-E data fits into this model. As stated by Rawer in *Annals Of The ISQY* (1967), "Recently, Whitehead tried to 'adjust' his theory to meet (all) cases, but not in a really convincing manner. Our opinion is that the question continues to be open." It is apparent that Sporadic-E cannot be easily explained or correlated with other natural events for all cases by any one model. However, thanks to a number of long range observations made by the combination of both scientists and ham radio operators, certain facts about Sporadic-E have been determined.

The following are known facts about Sporadic-E events that have been culled together from these observations and the various books written on the subject. Any model or theory has to be able to address these observations:

Known Sporadic-E Facts:

1) There are two distinct Sporadic-E seasons, winter and summer.

2) The summer season is always more intense than the winter season (on the order of 4 times greater).

3) Sporadic-E openings in the months of September and March are rare, particularly in higher latitudes of the temperate zones.

4) Metallic ions of silicon, sodium, iron and magnesium have been detected in the composition of the Sporadic-E cloud by rocket studies.

5) Cloud dimensions are typically several-hundred yards thick and several miles wide.

6) Openings can range from five-minutes to twelve-hours in duration.

7) The number of observations vary with latitude position, with the frequency of events increasing as you approach the equator.

8) Sporadic-E takes place in the E-layer because of density, composition and temperature factors that make the E-layer unique.

9) There is no direct-relationship between Sporadic-E and the sunspot cycle, the sunspot count

affects the F-layer more than the E-layer of the ionosphere.

Viewing the first four items in this list, one would have to suspect that there is a definite solar input to the Sporadic-E equation. Many operators have noted that five or ten minutes before hearing a Sporadic-E opening, a fluttering or light chattering sound will be heard. It almost gives the impression that a capacitor is being charged. Only in this case, it appears to be a charging action in the E-layer of the ionosphere. What is happening up there?

The Sporadic-E phenomenon consists of several key components that must be present to make it occur. The first is the existence of the metallic ions in the E-layers. Next is the process where these particles are charged or excited. Finally, there is the process where these particles are accumulated into cloud formations that are capable of reflecting radio signals. Temperature is also a factor in the Sporadic-E equation, during the excitation of these particles.

Sporadic-E, Aurora and Meteor Scatter are cousins to each other. As opposed to F2 skip, these modes cover smaller size regions during an opening. They all take place in the E-layer and it is sometimes difficult to distinguish between these events when they occur. It has been seen that on occasion, an intense Aurora opening may lead into a Sporadic-E event and likewise, some meteor openings may develop into short Sporadic-E openings. The major difference between meteor showers and Sporadic-E events are that openings caused by meteor shower activity will rarely exceed one minute in duration while the Sporadic-E cloud layer will last much longer. This is because the typical meteorite is less than one quarter inch in diameter and though there may be thousands of these meteorites, the "layer" formed by these meteors when they ablate in the atmosphere is not uniform and has many holes. Many of these meteors have metallic composition, not unlike the composition of the Sporadic-E ion cloud. In the case of the E-ion cloud, the ions have ionization potential charge transfer with air molecules and following dissociative recombination is excluded. This explains why these cloud layers have long duration. The one question that remains is do the metallic ions that comprise these clouds come from meteors or from other sources too?

Due to the metallic composition of the E-cloud, there are really only limited choices where these ions come from. They are suspected by scientists to come primarily from meteors but the sun cannot be ruled out as a potential source. This is because of the seasonal nature of the Sporadic-E phenomenon. It has been generally observed by hams on Six Meters that the meteor showers themselves do not result directly into Sporadic-E events. The burn rate of the meteors in the earth's atmosphere is not even close enough to generate the amount of activity for sustaining a normal Sporadic-E opening. Also, meteor showers are more or less date-specific where Sporadic-E events have not been tied to a specific relationship. However, while meteor showers may not be directly tied to Sporadic-E, the metallic particles from these showers that remain in the E-layer provide the most likely source for the particles in a Sporadic-E cloud. There must be a subsequent action that charge these particles or even contribute additional charged particles as part of the process. This leaves the sun as a most likely candidate as the source required to charge the particles into a Sporadic-E opening.

It is probable that if any of the scientists who study this phenomenon had an Amateur Radio background, improved knowledge could be gained by continuous observations of certain frequencies. A strong case could be made for keeping a daily log on the 50 MHz band. For the majority of the time, this band is very quiet. However, it sees not only Sporadic-E propagation, but also meteor, Aurora and F2 skip which experienced operators can identify. While Sporadic-E can be observed on bands such as 10 and 15 Meters, it may be harder to detect the phenomenon of "short skip" that accompanies Sporadic-E because the high amount of activity on those bands from F2 skip may obscure the opening such that hams do not notice it. Likewise, this would be a drawback for observing Sporadic-E on the FM broadcast band in the 88 MHz range. By contrast, Six is quieter and the effects of Sporadic-E openings and related phenomena can easily be seen. There is also no fear of missing an opening due to a lack of radio amateurs on the band at the time of an opening on Six Meters. This is because there is a large number of beacons worldwide in the low part of the band from 50.0 to 50.1 MHz that can be monitored in the event of an opening even when no operators are around. Table 9-1 shows the results for days for which I heard openings on Six Meters in 1992 at my home QTH in Long Island.

The first conclusions I drew from listening on Six was that previous statements made by hams and radio publications about when Sporadic-E occurs are not quite correct when they say Spo-

radic-E is common in the Spring and the Fall in the Northern Hemisphere. Rather, the bulk of the Sporadic-E openings are clustered around the shortest and longest day of the year, June 21st and December 21st. Sporadic-E openings were scarce at my location during the equinox season, typically on the days surrounding September 21st and March 21st. Though not impossible, openings in the months of March, April, September and October are rare in the Northern Hemisphere, particularly in the higher latitudes of the temperate zones. Using what I observed, coupled with other radio amateur observations, there seems to be a basic pattern for Sporadic-E openings that is repeated from year to year with some variations. A pattern is being formed: the openings appear to be independent of sunspot count but correlate well with the latitude locations of sunspots and with certain angles of the earth to the sun during the year. This holds the key to the mystery to why Sporadic-E occurs when it does.

Smith shows that Aurora propagation was very common in latitudes above 60 degrees and for the northern Aurora zone, the intensity was greater by as much as three to one on the Canadian side versus the Siberian side. There is no doubt that the location of the magnetic North Pole in the northern part of Canada is one the main reasons for this. In fact the location of the pole at 100 degrees W and 76 degrees N in most physics books corresponds with the graphs by Smith that shows the highest percent of Aurora openings surrounding the pole area. The phenomenon of Aurora openings in the temperate zones corresponds well with days of very high electromagnetic activity. Sporadic-E on the other hand has no correlation with days of high electromagnetic activity. This can be determined by using statistical means on daily Kp index data compared with daily Sporadic-E observations. Yet even though Sporadic-E and Aurora propagation are not directly related, there is an indirect relationship between the two that tie into the unique physical characteristics of the earth and its relationship to the sun.

A vivid example of the earth-sun relationship is the spectacular solar flare that occurred on September 7, 1973, which was observed by the Skylab astronauts. Two days later the astronauts were able to visually observe intense Auroras over the south geomagnetic pole, which resulted from particles ejected from the sun during the flare. The geomagnetic Kp index jumped to a value of eight on the ninth of September. The Auroras were approximately 80 kilometers above the earth in the E-layer region and it is probable that Aurora type propagation would be heard on the VHF frequencies. It's important to note that the initial flare did not cause the Aurora formation since there was a two-day delay, rather it was subsequent particle eruptions from the active area after the initial flare explosion. Aurora-type propagation is a combination event that involves flare activity from the sun interacting with the E-layers around the magnetic poles. It would is probable that the sun would be a major factor in the case of Sporadic-E. On the basis of yearly observation, there is a strong correlation with the angle of the earth to the sun during the course of the year.

The earth's axis of rotation is at a 23.5 degree tilt from the plane of its orbit around the sun. It maintains this tilt throughout its orbit around the sun. Think of it as a fixed plane that rotates

Table 9-1

1992 Six Meter Daily Observations at WB2AMU (41 N 73 W)

Number of days for which propagation occurs

Type	J	F	M	A	M	J	J	A	S	O	N	D	Total
Es	1	0	0	0	15	13	6	1	0	1	2	7	46
F2	3	1	0	0	0	0	0	0	0	0	0	0	4
Au	0	0	0	0	1	0	0	0	0	0	0	0	1
Meteor	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	4	1	0	0	16	13	6	2	0	1	2	7	52

Table 9-2

Summary of major rocket studies of Ion composition during Sporadic-E and related phenomenon

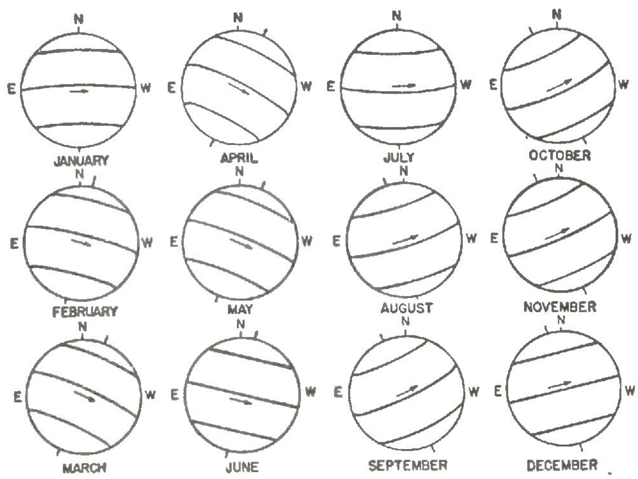
Date	Time	Location	Height above Earth	Ions found (in order of abundance)	Layer Formation
6-15-60	0800 MST	European USSR	103.5 km, 105 km	Magnesium, Iron, Silicon	Sporadic-E
10-31-62	1200 CST	Eglin AFB, Florida	85 km	Magnesium, Sodium Calcium	Sporadic-E
3-6-65	0132 CST	Ft. Churchill, Manitoba	100 km	Magnesium	Aurora
11-16-65	1222 CST	Eglin AFB, Florida	1) 94 km 2) 111 km	1) Iron, Magnesium, Calcium, Aluminum, Sodium 2) Silicon, Iron, Magnesium	Meteor (Leonids) Meteor (Leonids)
11-17-65	2320 CST	Eglin AFB, Florida	89 km, 93 km	Iron, Magnesium, Calcium, Nickel	Sporadic-E/ Meteor
1-26-66	—	White Sands, New Mexico	106 km	Magnesium, Sodium, Silicon, Iron, Aluminum, Calcium	Sporadic-E
4-12-67	1849 CST	Eglin AFB, Florida	1) 93 km 2) 105 km 3) 115 km	1) Magnesium, Iron 2) Iron 3) Silicon, Iron	Sporadic-E Sporadic-E Sporadic-E
8-12-76	1054 CST	Wallops Island, Virgina	101 km	Sodium, Magnesium, Silicon, Aluminum, Calcium, Iron, Manganese, Titanium, Copper, Nickel, Potassium	Meteor (Perseids)

around a sphere. During the longest day of the year in either the North or South hemisphere, that area is tilted directly towards the sun at 23.5 degrees. It is the same angle in the negative direction during the shortest day of the year which takes place in the winter. See Figure 9-2 (p. 64) for the way the sun appears to the earth during the different times of the year. Sporadic-E events have a high correlation to when the earth is in this particular plane during the winter and summer months which suggests a possible correlation with the active regions of the sun. Not only do sunspots appear in these active regions, but also other solar activity such as flares and prominences. It is well known that a large solar flare can wipe out most HF communications. Solar flares are an example of varying intensity charges that will interact with the ionosphere of the earth in different ways such that radio frequency communications will either be enhanced or inhibited. The composition of flares can be determined by the use of special filters that are tuned to the spectral wavelength of the elements. Elements such as magnesium, silicon, sodium and iron have been found in flare events. Hence, it is probable that at some point after the initial flare event, these flare particles interact with other metallic particles in the E-layer and charging action occurs. Throughout the solar cycle, the active regions of the sun move toward the equator until a new cycle begins. Hence, flare activity will follow these active regions.

Yet while Sporadic-E is not directly linked to sunspot count, it has a direct relationship with where the sunspots are located on the sun during the solar cycle. Science texts that discuss the sun agree that the sunspots reside in the most active area of the sun where other activity such as flares and prominences are active. Throughout the 11-year sunspot cycle, this region will not exceed 40 degrees in latitude or go below 5 degrees. Hence, the sunspots are a visual indication of where the most active regions of the sun are at any particular time. Figure 9-3 (p. 65) graphs the location of the sunspots with regard to the 11-year cycle, and Figure 9-4 (p. 66) depicts the latitude variation of sunspots throughout the cycle. It is curious to note that during the yearly cycle, Sporadic-E activity seems to be present when the earth is polarized in the same plane as the active region of the sun. Think of both the earth and the sun is this position as two separate dipole antennas that have the same polarization. The yearly variations between the latitude position of the sunspots are small, so that Sporadic-E activity appears to happen during the same time, year in and year out throughout the solar cycle. Sporadic-E activity appears to increase during the years when the active regions are closest to the sun's equator.

The increased distance from the sun to the earth is the reason why Sporadic-E events occur during the winter months at lesser intensity.

Figure 9-2



These are the relative positions of the sun as seen from the Earth throughout the year. Notice how the active zones of the sun are parallel to the Earth's equator during the winter and summer months. (from Sunspots in Action, by Stetson)

When either the north or south hemisphere is in winter, it still receives hits from the sun's active region but at lesser intensity due to the increased distance from the sun. Scientific data by Chadwick shows that during the June solstice, the northern temperate region gets an average of 40% daily Sporadic-E openings while the southern temperate zone which is in winter sees about one-third as many openings at the same time. This trend is reversed during the December solstice when the northern zone is in its winter season. During the equinox season, the angles are less favorable for maximum exposure of the earth's temperature zone to the active regions of the sun.

The sun, like the earth also rotates on its axis and takes approximately 27 days to complete. In addition, the sun rotates at seven degrees to the earth's plane of rotation so there is some variation here. Hence, the areas of high activity as indicated by sunspot clusters will be in a different position as the earth faces the sun each day. This would explain why in the summer months, there may be several consecutive days of Sporadic-E occurrences punctuated by a few days of no activity. The activity may appear at random when in fact it is merely a function of when certain areas of the earth are exposed to areas of the sun that are projecting high levels of activity. A key piece of information comes from *Sunspots In Action* which states, "It is statistically true that the nearer the spot passes the center of the sun's disk, the more likely we are to experience terrestrial disturbances." Therefore, the Sporadic-E model not only has to take in account the intensity of the sunlight (or distance between zones of the earth to the sun), but also the position of the earth to the active zones of the sun. It appears that the angle or view of the sun to the earth during the summer and winter months is more conducive to conditions promoting Sporadic-E.

The fact that the southern latitude of the northern temperate zone seems to record more Sporadic-E events is a scientific reality. Data by Smith shows that Sporadic-E activity is highest in the northern hemisphere at latitudes from 10 degrees through 30 degrees during the June solstice. This is because in the summertime, the sun is closest to areas surrounding the latitude 23.5 N. Areas further north in latitudes above 30 N. will see proportionally less Sporadic-E events and that has been proven by scientific observations. Also, the zone that is in winter sees Sporadic-E events at a lesser impact than the zone that is in summer because of increased distances between that zone and the sun. At my QTH in Long Island, I have seen about a 75 percent reduction in the duration and in the number of Sporadic-E openings on Six in winter. This model provides the basic explanation for Sporadic-E openings in the temperate zones. Now let's examine the other zones.

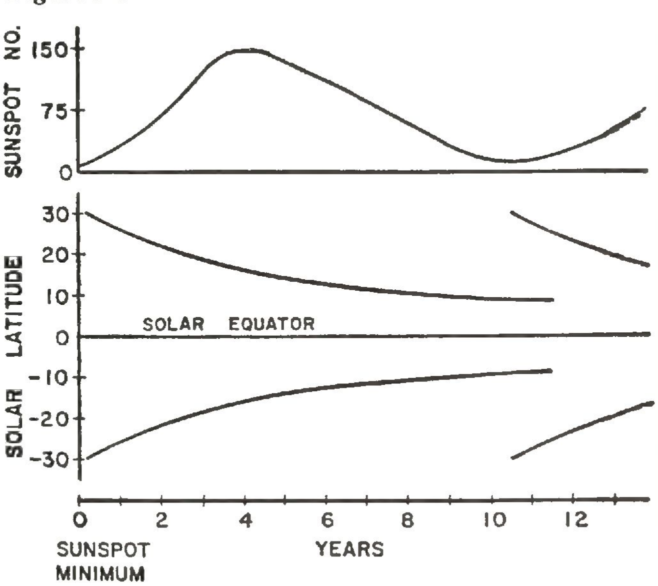
The Aurora zones see a certain kind of Sporadic-E activity that is known as Aurora. This phenomenon is distinguished by the fluttering or echo sound that occurs on radio signals during this propagation. The Aurora openings are tied directly to major solar disturbances that result in high magnetic activity in the Kp index. The Aurora zones have the highest incidence of Aurora events because of the fact that the magnetic field strength in this area (because of the proximity of the magnetic poles) dominates the E-layer above it. Aurora is dominant in this zone more than the Sporadic-E activity that frequents the temperate zones that border the Aurora zone. Sporadic-E activity drops off considerably at about 55 degrees latitude where the Aurora zone begins. The Aurora zone is not exactly concentric around the earth as it shows bending downward in latitude in the area of the magnetic poles. For example, the magnetic North Pole is generally in the area of 76 degrees N and 100 degrees W (the poles move gradually) and the bend of the Aurora zone follows the longitude of the pole. The same holds true with the bend around the South Pole at 66 degrees S and 139 degrees E. Aurora openings that do occur in the temperate zones tend to happen in the northern latitudes of those zones, typically above 30 degrees latitude. From the Smith book, G. King states in the paper, The Night-E Layer, "During magnetic and ionospheric

storms, the Aurora may be seen well south and north of its normal locations, and then night-E may be seen with this extended zone." He also states, "It is commonly accepted that Auroral and magnetic activity go together." The Skylab observations in September of 1973 substantiate the relationship between solar flares that result in high magnetic activity and the formation of an Aurora in higher latitudes of the earth. Hence, the region between 30 and 50 degrees latitude of each temperate zone will see a mixed bag of Sporadic-E openings and Aurora openings while not getting the maximum effect of either.

The Equator sees continuous Sporadic-E activity throughout the year with some variation. Scientists have determined that this is because the equator of the earth is getting the benefit of maximum exposure of the solar equatorial electrojets. Because this is a unique phenomenon, scientists dub Sporadic-E activity in this region as Es-q. The equatorial zone is approximately five degrees in width and it shows distortion on this global ring on the same longitude as the magnetic poles. The equator sees no Aurora openings as it is too far away from the poles to feel the effects of this type of electromagnetic activity. Hence, Sporadic-E openings are not attenuated by the same parameters that govern Aurora openings and the intensity of the sun has a greater effect here.

There are several variations to the basic causes

Figure 9-3



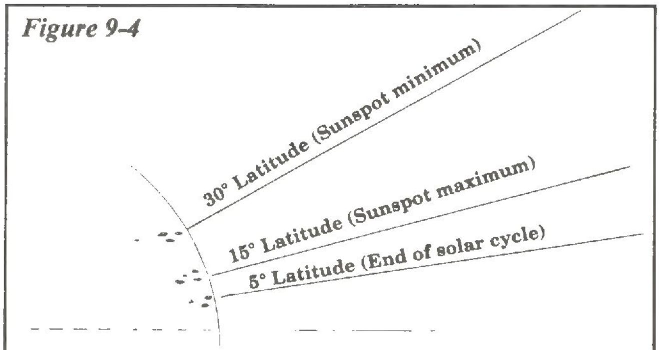
This figure shows the location of the sunspot regions by latitude on the sun throughout the course of the solar cycle. The location of the sunspot, rather than the count, is a correlating factor to Sporadic-E openings in the temperate zones of the Earth.

of Sporadic-E. From Smith's book, *Sporadic-E Propagation,* one of the writers, S. Matsushita, has found that there is a lunar effect on some Sporadic-E openings, particularly in the area of the equator. Also from the same book, David Layzer has noted, "A marked rise in the incidence of Sporadic-E has also been found to accompany some meteor showers." This is certainly true with the data collected by hams during the Perseids meteor shower that occurs in mid-August. Also, there are some regions in the world that see higher Sporadic-E activity than other areas at the same latitude. Scientific data has shown this to be true in the area of Japan and Southeast Asia. These variations will require further study into other factors such as higher mean temperatures and magnetic field variations.

There is no evidence of positive correlation between Sporadic-E activity and thunderstorms. This is stated by many scientists and is proven by the use of statistical tools that shows independence of the two events; Sporadic-E and thunderstorm activity. This same math tool shows independence between the daily Kp readings and the observance of Sporadic-E happenings in the temperate zones. In the case of thunderstorms, it is more of a coincidence of severe electrical activity with thunderstorms. The Sporadic-E clouds are located in the E-layer which is approximately 70 miles from the earth's surface. Thunderstorms typically occur at less than ten miles from the surface of the earth. It is inconceivable that a local event such as a thunderstorm would affect the E-layer which is 60 miles higher in altitude. It is more likely that some events that precipitated E-cloud formations may aid in inducing a thunderstorm if the particles settle down. Also, even though more thunderstorms occur in the summertime when most Sporadic-E activities occur, this does not explain why there is a significant number of Sporadic-E events in the winter when there is little thunderstorm activity. It is more probable that thunderstorm activity may indirectly affect the direction that the Sporadic-E cloud travels. Again, routine observations of the radio frequencies do not show a direct correlation between the two events.

The same reasoning holds true for the windshear theory. If windshear is the sole reason for the formation for Sporadic-E clouds, then Sporadic-E activity should appear anytime during the year at random, as winds are constantly present in the E-layer. However, even routine observations at certain latitudes will show that Sporadic-E activity is not purely a random event, as it has peak times when it appears as well as

Figure 9-4



This figure shows the sunspot regions at certain milestones during the course of the sunspot cycle. Sporadic-E openings in the temperate zone follow solar activity in the areas of the sunspots. The yearly variance of Sporadic-E in the temperate zones of the Earth closely follows the migration of the sunspots on different latitudes of the sun throughout the solar cycle.

times it almost never appears (the fall and spring equinoxes). Hence, the windshear model cannot be used as the sole explanation for Sporadic-E as it is a random model attempting to explain a natural event that follows a yearly pattern. If Sporadic-E was caused solely by windshear, it should appear during the fall and spring equinoxes at the same rate as summer months. The windshear model does not explain where the metallic ions in the E-layer originally come from. At best, it could explain movement and breakup of E-clouds.

Sporadic-E has a strong daytime or diurnal presence. Yet some Sporadic-E events seem to appear at night, sometimes occurring many hours after sunset. This could be a case of a cloud reforming at night after having appeared earlier during the day and had dissipated. It is known that during peak times, highly-charged plasma clouds may break up and reform several times. Another possiblity could be that all of the factors required to create a Sporadic-E event may not have been in place until after dark. Temperature of the E-layer is a subtle possibility. Additionally, it is surmised that there are many more Sporadic-E cloud openings that are never observed because of their location at the time. This would be true of clouds that develop over large areas of water such as an ocean or over sparsely-populated areas. This is true for a double hop Es opening from the eastern United States to Europe where there would be at least two clouds over water.

The end of a Sporadic-E opening or dissipation of the ion cloud is most likely caused by the loss of charge of the metallic particles. Basically, this would result in the particles becoming invert or going back to the neutral status and the cloud would break up. Temperature change or wind changes could be factors for this change. It is probable that a significant number of these metallic particles still remain in the E-layer until they are all charged again for another Sporadic-E opening. There have not been many Sporadic-E openings recorded after 1 a.m. local time so the charging mechanism is not present then.

The different zones of the earth could play a part for radio amateurs in planning a VHF expedition to various locations at different latitudes. An expedition to the area of the Equator would mean looking for daily Sporadic-E openings on Six while a trip to northern Canada would involve looking for Aurora-type propagation. Amateurs in the temperate zones should concentrate during the summer and winter months for monitoring Sporadic-E, realizing that the winter season will be about one-third the summer activity. The beauty about Sporadic-E propagation on Six is that generally low power can be used with reasonable success and any modest station setup is more than sufficient to observe this phenomenon.

In conclusion, it has been shown that there are three distinct zones for Aurora and Sporadic-E propagation: Temperate, Equatorial and Auroral. There are yearly Sporadic-E propagation patterns that are seen in each of these zones for which the sun must be a major factor. The formation of Sporadic-E and Auroral formations in the E-layer of the ionosphere are the result of incoming metallic ions that are ejected from the sun. The fact that Sporadic-E follows a yearly pattern leads to the conclusion that the sun is most likely a key part of the Sporadic-E phenomenon as opposed to other theories which cannot explain this yearly pattern. Additional research will be required and Six Meters will continue to be a key band for Sporadic-E observations.

Chapter 10
Esoteric Modes

This chapter will cover some of the esoteric modes that are used on Six. It is hard to imagine anything more esoteric than Six itself, as it is used by but a small percentage of the Amateur Radio population. But, some of the modes used on Six represent an even smaller subset of the mainstream activity such as FM or SSB. The problem with getting started on these modes is finding basic information and finding others with the same interests in your region. A basis summary is provided for each of these unique modes in this chapter and it is recommended that for further information, one should consult the various VHF clubs and organizations for those who operate these esoteric modes.

EME

Earth-Moon-Earth (EME) is an esoteric mode in ham radio on several VHF bands. On Six, this mode has been poking around for a number of years, but it has not developed into a large following at this point. There were some experiments on Six with this mode as early as 1960 but since that time there has been only gradual growth for 50 MHz EME. The first documented Six Meter EME QSO took place in 1972. Without going into great detail about EME, the mode requires a signal that is sent from one region on earth directly at the moon and bounced back to another region on earth. Typically, there are a few days each month when the moon is ideally situated over the horizon for EME contacts. Tracking of the moon is required and antenna arrays must have flexibility in movement. As you can imagine, the antennas and their setup are somewhat involved, usually consisting of stacked arrays raised on high towers. Power levels tend to be on the high side to overcome the loss over such a long path. Another problem is antenna size for this band. Frequencies like 144 and 432 MHz are very popular in EME work because it is easier to build very high-gain antennas due to the smaller wavelength. For Six, to get the equivalent gain as the higher frequencies, more antenna space is generally required. For all of the VHF frequencies, there is an inherent problem of high noise level that has to be addressed.

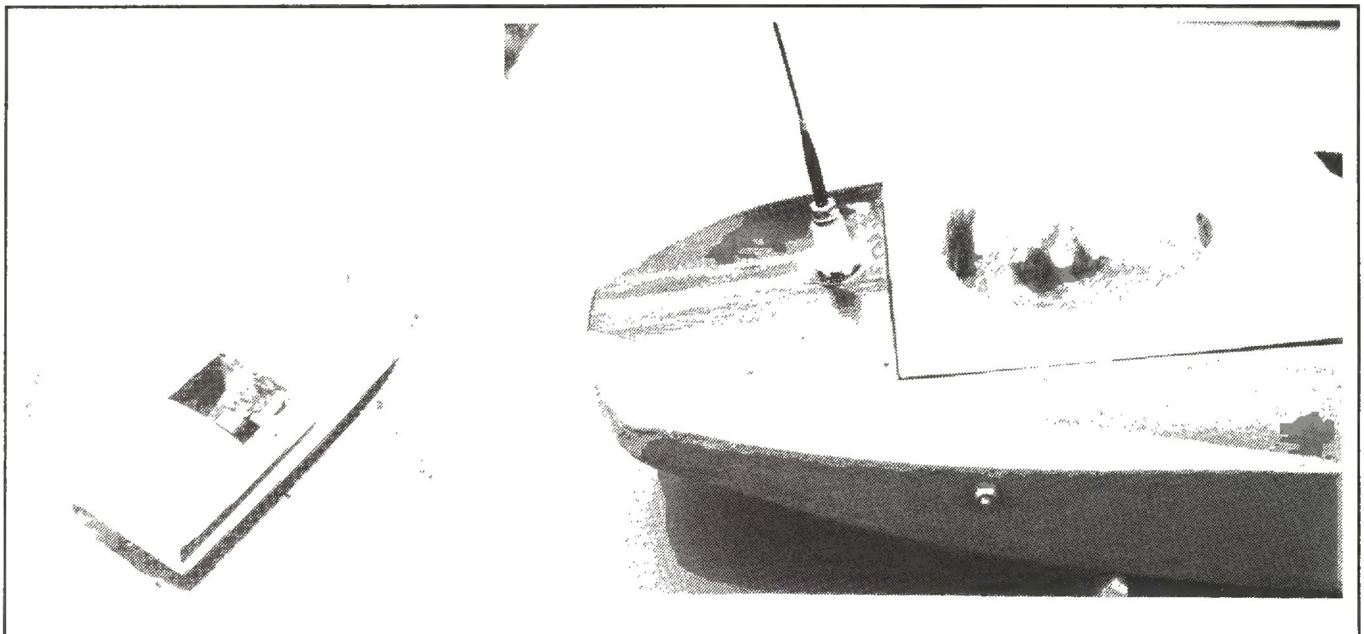
Currently there are only a few hundred hams in the world that are experimenting with Six Meter EME. The reason why Two Meter EME seems to be more popular is because this is the best way that DX can be worked on this band. Also, Two Meter antenna arrays are smaller. There is not a lot of inherent appeal for EME on Six because the band already has long-range DX capabilities via F2 propagation, Sporadic-E, Transequatorial and Aurora using simple and conventional station setups. Six is a borderline band that exhibits HF tendencies and to set up a Six Meter EME station would almost be like setting up an EME station for Ten Meters. However, the real potential for Six Meter EME would be the ability to work into areas of the world that are seldom heard via the 'conventional' modes of propagation. This would be the real attraction of this mode to experimenters and it will be interesting to see if there is significant growth for this mode in the future.

Radio Control

Six Meters is the only amateur band used for radio remote control which is known as R/C. This is a case were two hobbies are combined; ham radio and model aircraft. The R/C range on Six is from 50.8 to 51.0 MHz with 20 kHz spacing. The 10 channels are 50.800, 50.820, 50.830, 50.860, 50.880, 50.900, 50.920, 50.940, 50.960, 50.980 and 51.000. Legal restrictions include a maximum power of one-Watt and the operator's name and call has to be on the receiver.

Most hams would be surprised to know that R/C has been around before the days of repeaters. My father, Ray Neubeck, W2ZUN, used Six for radio control work on model boats in the late 1950s. His model boats used a vertical antenna placed on the bow of the boat for receiving control signals. Most current R/C work on this band is with model airplanes and rockets. In general a large, open field is desired as full visibility with the aircraft or rocket is required. This is to avoid any potential problem with low flying aircraft as well as keep a clear line-of-sight between the transmitter and the aircraft or rocket.

For model rockets, Six is used in two areas, radio direction finding (RDF) and radio control (R/C). RDF is ideal for tracking a rocket when it has landed even if you have lost sight of it. This is accomplished by a transmitter in the rocket that will send out signals. By using a receiver



A vintage radio-controlled model is shown here with a Six Meter vertical mounted on the bow. This boat was built thirty years ago by the author's father, Ray Neubeck, W2ZUN. Ray used Six Meters to send directional control signals to the boat's rudder. — *photos by Ken Neubeck, WB2AMU.*

with a directional antenna, you can locate the rocket. For R/C, a receiver is placed in the rocket along with a DTMF decoder/controller attached to it for interpreting tone sequences. The DTMF signals are sent from a radio on the ground, usually a handheld walkie-talkie with a no-gain antenna attached to it (such as a vertical). Various control commands such as a radio-controlled launch, stage control, chute ejection or various other options are sent by radio. Model rocketeers will generally conduct ground tests to test these various commands prior to actual deployment in flight. By the way, Six Meter FM simplex turns out to be an excellent mode for communications between the control station and the rocket search crew as rocket landings can be far away due to wind factors.

Radio controlled planes follow the same general format, where FM pulsed tones are used to control the proportional control of the servo motors which are attached to flight control surfaces of the plane. Direction of the plane is controlled by the use of the flight control surfaces. For this hobby, the range of 72 to 76 MHz has also been set aside for the flyers with a maximum power output of .75 Watts. The great majority of the flyers use this frequency range but those hams involved in the hobby such as Sid Wolin, K2LJH, take advantage of the Six Meter R/C frequencies. According to Sid, the Six Meter sets used for R/C are identical to the 72 MHz sets for about the same price. This includes the FM pulse coded transmitter, receiver, charger, batteries and three servo motors for under $150. Be aware that flying may be restricted to authorized locations in your area and that special insurance along with a proficiency certificate from the American Modelers Association are required.

One can see how even a small portion of Six Meter band space has another hobby which has a diverse range of applications. There are less QRM problems on the Six Meter frequencies as opposed to other R/C frequencies and this makes it an ideal band for this hobby.

AM

Perhaps Amplitude Modulation (AM) isn't really an esoteric mode, but there isn't a lot of people on it in general except for 6 Meters and 75 Meters. It is true that most transceivers have AM as a regular feature but for many hams this button is never used. In fact, true AM operators seem to use vintage radios, modified commercial radios or even homebrew gear. This is very much true on Six as most modern day transceivers on Six have reduced power and one would have to find a vintage linear amplifier for Six Meter AM if he wanted more power.

The AM calling frequency for Six is 50.400. This is also the regular schedule frequency for Six Meter AM groups scattered throughout the United States. Schedules are held very late at night or early Sunday mornings to avoid possible interference problems.

The AM mode is still hanging in there on Six as some growth has been realized in recent years. This can be attributed to the difficulty in finding used AM gear and maintaining them in working order as well as a public relations problem. There is little publicity about the AM mode in the mainline Amateur Radio magazines and publications. What little publicity exists is sometimes negative. AM signals have been frowned upon on the crowded HF bands because AM takes up more spectrum space, but on a large band like Six Meters, this is not a problem at all. There are a few ways that a newcomer to ham radio will be exposed to the existence of this mode on Six Meters. Sometimes a local ham who is already on this mode can assist one in getting started, but this is not a widespread happening on Six.

In fact, the California Six Meter Club has taken the bull by the horns. Club members have been restoring Six Meter AM rigs that have been donated or sold to the club for low prices. The rigs are then loaned to those looking to get started on Six Meters. An AM roundtable net is held on Sunday mornings with over a dozen check-ins. There are similar nets elsewhere in the United States that are built up by the same method of restored AM equipment.

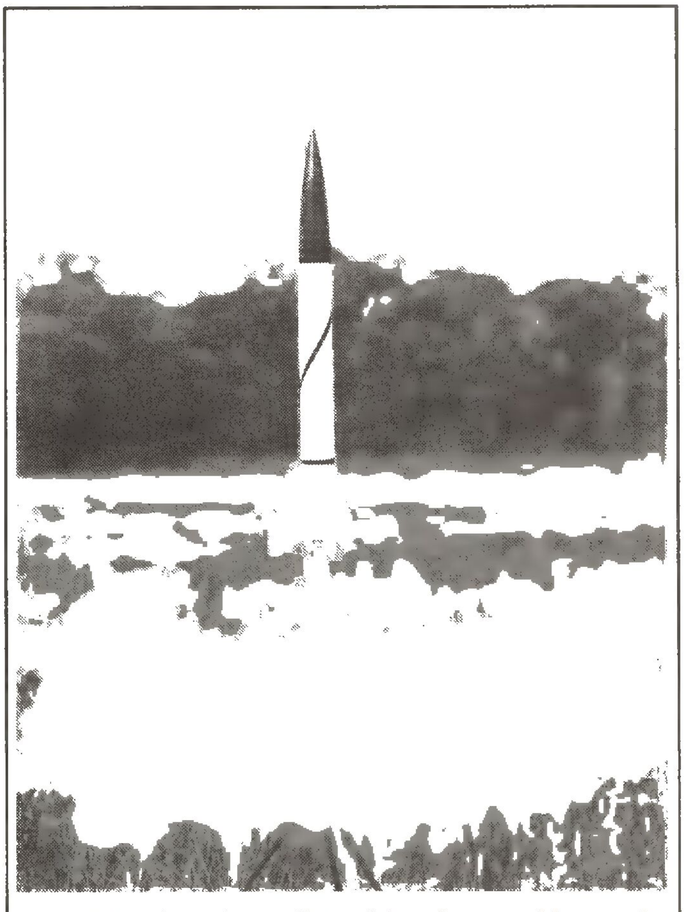
Realize that vintage AM gear on Six may require some overhaul and repair. As mentioned in Chapter 3, things like electrolytic capacitors, coil windings, wiring and tubular resistors are components that do not age well and will require eventual replacement. Replacing tubes in the older rigs will sometimes require a search at the local flea market. Sometimes modifying the circuits by replacing tubes with FETS may be the only alternative that you have in keeping these rigs working.

Beacons

Some words must be provided to describe the importance of beacons for the Six Meter band. While beacons are found on 14 MHz, 24.9 MHz and 28 MHz, they seem to be the most valuable on 50 MHz and the higher frequencies. Beacons are a relatively new phenomenon on the Amateur Radio bands with the ARRL pushing for them in the mid-1980s. On Six the majority of the beacons fall in the 50.000 to 50.090 range. In this range, 50.060 to 50.080 is where automatic beacons can be located. The smart operators listen for these beacons as part of their monitoring routine. Many times an operator can determine that an opening is occurring even when there are no stations currently on the air, just from hearing one or two long distance beacons.

The typical beacon setup is a keyer circuit hooked up to a low-power transmitter of five Watts or less. The antenna used is a simple antenna, usually a vertical, Halo or a dipole. The broader the antenna is, the greater use the beacon will be for Six Meter operators. There are no special licenses required for beacons, just as long as they do not interfere with existing beacons in the same area. The beacon messages are cycled each minute with information such as the callsign identifier, QTH and grid square locator.

Beacons take on an identity of their own after you hear them on a number of occasions. They are reliable navigation aids not unlike the marine buoys that mark nautical channels. Some of those that are one grid square away seem to always be there for you in case you hear nothing at all on the band. Other beacons seem to consistently be there when an opening occurs. This is true for me from my QTH in Long Island when I hear the W5VAS beacon in New Orleans, Louisiana. This beacon generally comes in when a Sporadic-E opening to the southern states develops even when I do not hear any other stations. This particular beacon is run by Hank Arsaga, Jr,



A model rocket taking off. Model rocketry and ham radio are combined through the use of radio control signals on the Six Meter band. — photo by Ken Neubeck, WB2AMU.

Table 10-1

Selected list of beacons in North America

Frequency	Callsign	Grid Square
50.008	KØGUV	EN26
50.027	XE2UZL	DM10
50.039	VO1ZA	GN37
50.058	VE3UKL	FNØ3
50.060	W5VAS	EM4Ø
50.060	N4TQR	EM63
50.061	WB9STR	EN61
50.065	KD4LP	EM86
50.068	W4RFR	EM66
50.068	K6EF	DM13
50.069	N4LTA	EM94
50.069	N4MW	EM55
50.069	WØVD	EM27
50.070	W2CAP/1	FN41
50.070	KS2T	FM29
50.072	WB4WTC	FMØ6
50.073	VE1BTT	FN65
50.075	WA4IOB	EM73
50.075	WB4OSN	EL95
50.077	W8UR	EN75
50.077	NØLL	EMØ9
50.078	WZ8D	EM78
50.078	TI2NA	EJ79
50.080	WB4OOJ	EL87
50.087	VE2TWO	FO13

Note: For further listings, please consult the ***Callbook*** *or the* ***ARRL Repeater Directory****.*

W5VAS. and it puts out 100 Watts. That is higher power than most other beacons because its aim is to aid in support of scatter propagation. The transmitter is a Motorola which puts out the message, "de W5VAS bcn NOLA pse QSL" continuously on 50.0601. The data is generated by a diode matrix and the keying circuit is a simple switch-on circuit where the keying is done by returning the crystal channel element to ground. This switching to ground is done in the early stages of the oscillator so that key clicks are reduced. The antenna used is a homebrew Squalo that is up 185-feet above ground. It seems that it is good to have both high power and low power beacons on the band as low power beacons will tell you when the band is really hot while the high power beacons will be there when there is a weak band opening.

There are those beacons that seem to be situated in the middle of nowhere, yet they can provide a great deal of help. The VE2TWO beacon is situated in grid square locator FO13 and is located way up in the northern part of Quebec. I hear this beacon about a half dozen times in the summer and have yet to work a station in the same grid square area. Yet this beacon gives me an excellent indication that a good Sporadic-E or Aurora opening is taking place north of my location towards Canada or northern states such as Minnesota or Michigan.

Table 10-1 provides a selected list of beacons that have been heard on a regular basis. One of the problems in maintaining a list of beacons is that new ones come on and some existing ones disappear. Consult the *ARRL Repeater Directory* or the *Callbook* for additional beacon listings in North America and elsewhere, but keep in mind that the list may not be up-to-date.

Beacons have proven to be a very valuable tool to the Six Meter operator who uses the band regularly and monitors the beacon frequencies as part of his routine.

Chapter 11

The Future of Six Meters

The Doors' song "Roadhouse Blues" has the line, "the future's uncertain and the end is always near," and this phrase seems to apply to the fortunes of the Six Meter band. This band has seen tremendous swings in its usage throughout its history and future events could certainly affect it again. Perhaps a more appropriate phrase is "the band that hams forgot." It seems ironic that hams are rediscovering this band after it had enjoyed popularity in the 1950s.

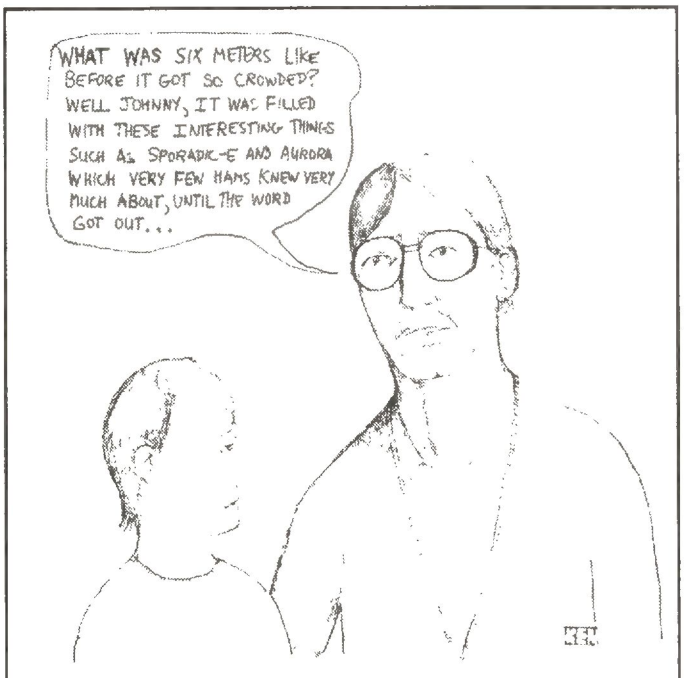
It will be interesting to see what will happen to Six Meters in the next few decades. Will there be a significant increase in activity both in the United States and abroad? It's important to remember that this band has been through periods of peaks and valleys. It enjoyed widespread use in the 1950s and declined after that peak. I don't see an explosion coming in the number of people who use this band in the United States. The band has achieved cult status from those who use it in the United States now and I only foresee gradual growth here. I think that the real explosion will occur in other countries where 50 MHz operating privileges are finally being allowed. This has been seen in the last few years for countries in Europe, South America and Asia. In many instances, the Six Meter population of these countries already exceeds the number of Six Meter operators for a number of states in the U.S.

From my travels in the U.S., I've seen that some areas show very good pockets of activity while other areas show a dearth of activity. It could be said that certain rural areas favor Six activity more so than suburban areas in the U.S. From what I see, activity in the southern states seems to be the strongest of all of the U.S. regions. Reasons for this include the fact that UHF television is used in these areas rather than VHF, thereby eliminating some TVI problems right off the bat. Also, overall propagation is better for these areas, particularly Sporadic-E and TE propagation.

A good sign for Six is that the newer transceivers include this band. This should attract more curiosity seekers to the band. Newcomers are pleasantly surprised at the interesting conditions on this band after they have purchased a new HF transceiver which also has Six Meters. Also, the large influx of codeless Technicians will look for other bands besides the crowded Two Meter band and Six would present a desirable alternative.

One thing that could change everything might be the addition of new bands into the Amateur Radio frequency allocations in the future. If radio amateurs were to get a new band between 30 MHz and 50 MHz, this could either help or hinder the popularity of Six. It could help Six Meters as hams would gain interest because any new band in this spectrum would have many of the unusual propagation modes that are seen on Six and would point newcomers toward checking out Six, too. A new band in this frequency range would not see the inherent TVI problem that plagues Six. It may be quite a number of years before something like this becomes possible but with microwave frequencies being the hot item, more HF/VHF spectrum space will become available. It is doubtful that hams would ever lose this band as perhaps the only commercial use is to establish another TV channel. Therefore, the only way usage would go down would be if hams move to operate on other frequencies on a regular basis.

In the meantime, the band continues to make a slow resurgence with slow and steady growth in the U.S. and overseas. The focus of the major ham



Reminiscing about Six Meters 25 years from now.

radio magazines should be presenting more feature articles with regards to Six rather than rely on regular VHF columns to spread the news. Columns are read by regular users of the band and are not necessarily a good place for potential newcomers to start from, other than perhaps whetting their appetite. There is much misinformation about Six and this is one of the reasons for its lack of use.

A good argument could be made to use Six Meters as part of an emergency network set up by hams. There is a considerable lack of QRM on this band whereas current local bands such as Two Meters are crowded. Six has better line-of-sight characteristics than Two Meters and this would be ideal for an area of coverage of 20 to 30 miles of radius. Recall that Six was part of the Civil Defense network in the 1960s and there is really no reason why it could not be used in a similar role today.

Along with this argument for establishing an emergency network, an effort must be made by radio organizations to promote more FM repeater usage on Six. It would be unacceptable to the interests of ham radio to allow the current situation to continue where there is a dearth of repeater activity on almost three MHz of space. Radio amateurs should strongly petition electronics company to make inexpensive Six Meter FM gear. Currently, there are only a few models that fill this need. The electronics company will jump into a market if hams create the need for one on Six Meter FM, particularly if the no-code Technician Class gets on the band in large numbers.

The type of ham that makes his way into Six Meters, off from the beaten path of the HF bands is a very special breed of ham. He essentially has to have a survivalistic approach to the band and be able to combat potential RFI problems. Once a ham gets on Six, he may get swept up into one of the more interesting subgroups of the 50 MHz range such as meteor shower work or AM work. The band not only has a myriad of propagation modes but it also has multiple modes of transmission. It could possibly be the greatest of all Amateur Radio frequencies because of this versatility. It is unfortunate that most hams are not even aware of these facts and the capabilities of this beautiful band.

I hope that if you have not tried Six Meters, you will please consider giving it a shot. If you already are on it, perhaps you could spread the word to other hams you know. The band has the room to accommodate an influx of radio operators. See you on The Magic Band!

APPENDIX

The following is a list of organizations and publications that are devoted to Six Meters. The list is by no means complete, but it will give one a good start toward contacting those with similar interests.

West Coast VHFer
P.O. Box 685
Holbrook, AZ 86025

"The Western States VHF Directory"
Tim Marek, NC7R
360 Prestige Ct.
Reno, NV 89505

Upper Midwest VHF/UHF Newsletter
17500 Cherry Drive
Eden Prairie, MN 55346

SMIRK
Ray Clark, K5ZMS
7158 Stone Fence Dr.
San Antonio, TX 78227

Also available from ***Worldradio Books....***

AERIALS II

by Kurt N. Sterba & Lil Paddle

A compilation of antenna columns which appeared in ***Worldradio*** from 1985-93.

$11.00 + $2.00 shipping and handling. California residents please add appropriate sales tax.

40+5 YEARS OF HF MOBILEERING

by Don Johnson, W6AAQ

This long-awaited and eagerly anticipated revision of Don's *40 Years of HF Mobileering* is a compendium of invaluable information on mobile antennas.

$14.95 + $2.00 shipping and handling. California residents please add appropriate sales tax.

WHEN THE BIG ONE HITS...*A Survival Guide for Amateur Radio Operators*

by Jerry Boyd, KG6LF and Jay Boyd, KN6BP

Tells Amateur Radio operators what to do to prepare for survival, safety of families and loved ones, remain self-sufficient until normalcy returns and perform disaster communications duties in an efficient and productive manner in the face of disaster. 56 pp.

$7.50 + $2.00 shipping and handling. California residents please add appropriate sales tax.

MORE ABOUT CUBICAL QUADS

by George McCarthy, W6SUN

This is a second book for George. His first, *Plus 20,* was published some time ago and he has authored many articles in the meantime. *More About Cubical Quads,* detailing his 25-year love affair (or probably more accurately — wrestling match) with the Quad antenna, has many building and installation tips garnered from his extensive experience. 64 pp. $10.00 + $2.00 shipping and handling. California residents please add appropriate sales tax.

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2120 28th St., Sacramento, CA 95818